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INFANT MORTALITY:
ITS RELATION TO SOCIAL AND
INDUSTRIAL CONDITIONS

BY HENRY H. HIBBS, JR.

FORMERLY OF THE DEPARTMENT OF RESEARCH
BOSTON SCHOOL FOR SOCIAL WORKERS
AND THE DEPARTMENT OF SOCIOLOGY
UNIVERSITY OF ILLINOIS



NEW YORK
DEPARTMENT OF CHILD-HELPING
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SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY
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INTRODUCTION

This series of papers, all of which have been published previously in periodical form, is the outcome of a house-to-house investigation of infant mortality in four wards of Boston made in 1910-11 and 1911-12 by the Research Department of the Boston School for Social Workers under a grant from the Russell Sage Foundation. During the second year the writer was in charge of the field work. He was later commissioned to write the report of the investigation for publication. In undertaking this task it appeared that no particular service would be rendered by publishing another study of the subject which dealt only with local conditions and which was prepared with only incidental reference to the data gathered elsewhere in other investigations. It did appear, on the other hand, that there was a place for a book dealing with the problem of infant mortality in the United States and based on all the studies of the subject that are available. A number of such investigations have recently been made in different parts of the United States but, so far, the results of these have never been brought together and compared with a view to finding the common relationships and laws involved. This series of papers is an attempt to meet this need. The sources of the study, therefore, are very numerous. Since, however, they are cited in footnotes in the various chapters they need not be mentioned here.

In view of the prominence given to previously unpublished data, gathered in the house-to-house investigation in four wards of Boston, it will be necessary to describe briefly the scope and method of this investigation. The four wards were 6, 8, 13, and 17, the boundaries of which correspond roughly with the sections commonly known as the North End, the West End (both of these lying in the oldest parts of the city), South Boston (lower half), and Roxbury (in part). The investigation was based on the calendar year 1910. Transcripts of the original records of all the births and infant

deaths which occurred in these wards were made from the copies on file in the office of the registry department of the city and visits were made to the homes of the mothers by Fellows in the Research Department of the School for Social Workers.* Interviews were obtained with the mothers of 2,063 infants.†

The infant mortality rates in this investigation, like those in the investigation by the U. S. Children's Bureau into infant mortality in Johnstown, Pa., were obtained by comparing the number of infants (whose parents could be located) who were born in the four wards in 1910 with the number of these same infants who died before they were one year of age, whether the death occurred in 1910 or 1911. The comparison was upon the basis of deaths to 1,000 births, stillbirths not being included.

The writer is indebted to Dr. Jeffrey R. Brackett, director of the School for Social Workers, and Dr. T. W. Glocker, formerly director of the Research Department, for the use of the data collected in the Boston investigation.

As the title indicates, the series of papers deals with the relation of social and industrial conditions to infant mortality. Certain conditions, however, that may be properly classed as industrial or social have been necessarily omitted. Among these omitted factors may be mentioned the character of the milk supply,‡ the influence of artificial feeding,§ and the form of the medical attendance. It has also been necessary to omit all consideration of infant mortality in institutions, of the mortality of illegitimate infants, and of stillbirths.

Finally the reader should be warned that the various factors that produce infant mortality are so closely interrelated and so difficult of measurement|| that conclusions stating the exact extent of the influence of each are not to be expected. It has thus been impossible to determine except very roughly

*Miss Helen C. Schindler, Miss Margaret O. Cook, Miss Helen L. Spencer, Miss Charlotte I. Clafin, Miss Bertha C. Lovell, Miss Alice M. McIntire, Mr. A. H. Lord, Mr. T. Eaton, and Mr. P. E. Shannon.

†This represents visits to about 4,000 homes, as about half the families sought for could not be found.

‡See, however, p. 63.

§There have been many excellent studies made of this subject. In consequence no extended treatment of it was considered necessary in this essay. See references on p. 49 and also pp. 25-26, 79-80, and 112.

||See for example pp. 59, 88-92, 95-96, and 113.

the relative influence of the various factors involved.* It has been possible, however, to show clearly that the social and industrial conditions studied do exercise an influence on infant mortality and to indicate roughly the extent and importance of their influence. If this warning is carefully heeded the reader will not be likely to feel that the writer has been led to over-emphasize the influence of certain conditions at the expense of others.

The greater part of the actual writing of the book was done in the statistical laboratory of Columbia University. The writer wishes to express his sincere appreciation to Prof. R. E. Chaddock, director of the laboratory, for this privilege but especially for his unstinting advice and help throughout the writing and preparing of the book for publication.

The writer wishes also to acknowledge the courtesy of the editors of the *Quarterly Journal of Economics* and the *Quarterly Publications of the American Statistical Association* and the secretaries of the *Southern Sociological Congress* and the *American Academy of Medicine* in allowing the papers to be reprinted in book form.†

*See for example pp. 21, 42-45, 81, and 115.

†The papers were written, however, with a view to their publication in book form. The work as a whole, therefore possesses a unity that it would not have had if each chapter had been written independently.

The papers are reprinted without changes except for slight modifications of titles. The reader will understand, therefore, that references in footnotes to "other articles" on infant mortality by the writer may be read as references to papers now included in this book.



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I.

THE PRESENT POSITION OF INFANT MORTALITY:
ITS RECENT DECLINE IN THE UNITED STATES

*Reprinted from the Quarterly Publications of the American
Statistical Association, New Series, No. 112,
December, 1915, pp. 813-826.*

I.

THE PRESENT POSITION OF INFANT MORTALITY: ITS RECENT DECLINE IN THE UNITED STATES.

The term infant mortality, according to the generally accepted usage, is employed to designate the deaths of infants under one year of age. The problem is measured by an infant mortality rate which is an expression of the proportion of infants dying under one year of age to 1,000 births or, when birth statistics are not available, to 1,000 population under one year of age. The deaths of infants at this early age is made the object of special study because they constitute such an enormous proportion of the deaths at all ages. In no other period of life do deaths occur with such frequency. This is evident upon examination of any of the bulletins on mortality statistics issued annually by the Bureau of the Census for the registration area of the United States. Thus, Bulletin 109 shows that 27 per cent. of the total number of deaths which occurred in the registration area in 1910 were of children under five years of age and 19 per cent., or almost one fifth, were of infants under one year of age. In 1911, 1912, and 1913 the deaths of infants constituted 18 per cent. of the deaths at all ages.

That the death rate for infants and young children should be greater than for other persons is not, however, surprising. As a recent English writer says, "The young of all animals are more susceptible than the adult to the influence of the environment and the approach of death. Hence, it is inevitable that, even under the most favourable circumstances the deaths of infants will furnish a large contribution to the bills of mortality."* It is not the mere fact of excess but the tremendously greater excess of deaths which occur during the first year of life that constitutes the problem of infant mortality.

Infant Mortality in Foreign Countries. The world-wide significance of the problem will be evident upon examination

* George Newman, M.D.: *Infant Mortality*. London, 1906, p. v.

of the following figures showing the infant mortality rate per 1,000 births for the foreign countries for which statistics are available during the five year period from 1906 to 1910:*

Chile.....	315	Finland.....	117
Hungary.....	204	Switzerland.....	115
Jamaica.....	191	The Netherlands...	114
Ceylon.....	189	Scotland.....	112
Prussia.....	168	Denmark.....	108
Servia.....	154	Ireland.....	94
Italy.....	153	Sweden.....	78
Belgium.....	141	Australian Common-	
Ontario.....	127	wealth.....	78
France.....	126	Norway.....	70
England and Wales	117	New Zealand.....	70

Thus, in one third of the countries of the world for which statistics are available the infant mortality rate was over 150, while in about one half it was over 125. In only 5 of the countries, 3 in Europe and 2 in Australasia, was the rate less than 100 deaths per 1,000 births. Expressed in another way this means that, out of every 1,000 children born in countries like Hungary, Prussia, and Italy, from 150 to 200 die before reaching the end of the first year of life; out of every 1,000 born in countries like England, Scotland, Switzerland, and The Netherlands, from 110 to 120 die before reaching this age; while in countries like Ireland, Sweden, Norway, and Australia, from 70 to 100 die before they are a year old.

Infant Mortality in the United States. Figures comparable with these exist for only a few of the states and cities of the United States. In 1911 the Bureau of the Census reported that only in the cities of Washington and New York and in the states of Pennsylvania and Michigan and the six New England States could the registration of both births and deaths be regarded as sufficiently complete (amounting to at least 90 per cent. of the total) to make possible the calculation of an accurate rate of infant mortality based on the ratio of births to deaths. This area comprises the provisional "registration

*Seventy Third and Seventy Fourth Annual Reports of the Registrar General for Births, Deaths, and Marriages in England and Wales (pp. xciv and 105-15 respectively).

area" of the United States for births and deaths. The infant mortality rates per 1,000 births for these states and cities in 1910 were as follows:

Rhode Island.....	158	Connecticut.....	127
New Hampshire....	146	Michigan.....	124
Pennsylvania.....	140		
Maine.....	135	Washington, D. C.	152
Massachusetts....	131	New York, N. Y..	125

Besides these states and cities where the registration of both births and deaths are regarded by the census office as being sufficiently or "fairly complete," there are others where the registration of deaths only is regarded as sufficiently complete to be included in what is known as the registration area for deaths. In 1910, 22 entire states and a large number of cities in non-registration states were included in this area. Since complete birth statistics are not available, it is not possible to calculate an infant mortality rate for this area in the ordinary manner—by computing the ratio of deaths to 1,000 births. To overcome this difficulty, the Bureau of the Census in its report on mortality statistics for 1910 employed an infant death rate based on the proportion of deaths to 1,000 population under one year of age in 1910. This method is confessedly inaccurate because the enumeration of the population under one year of age is never complete and entirely accurate. Yet it is the best method available for studying the distribution of infant mortality in the United States and, although its crudities should serve as a caution against drawing too fine conclusions from its use, its defects should not be over-emphasized. The following table shows the death rate per 1,000 population under one year of age for the registration states:*

Utah.....	82.3	Ohio.....	115.9
Washington....	84.3	Michigan.....	127.5
Kentucky.....	87.9	Maine.....	140.4
Montana.....	90.4	New York.....	143.6
California.....	92.2	Connecticut...	143.7
Minnesota.....	92.4	New Jersey....	148.8

* Bureau of the Census: Bulletin 112, p. 24.

Missouri.....	*96.7	Pennsylvania..	149.7
Colorado.....	104.5	Maryland.....	152.1
Indiana.....	106.9	Massachusetts..	160.8
Wisconsin.....	108.0	New Hampshire	164.9
Vermont.....	109.4	Rhode Island..	181.5

Thus the infant death rate per 1,000 population varied from less than 85 in the Western states, Utah and Washington, to 165 and 182 in the two New England states, Rhode Island and New Hampshire. It was 127.6 for the entire group of registration states considered as a whole.

It would be of interest to compare the rates for this group of states with those for foreign countries given in a previous table. But this is, of course, impossible since infant death rates based on population can not be compared with the true infant mortality rate based on births. In the 1911 bulletin on "Mortality Statistics," the Bureau of the Census estimated on the basis of the figures quoted here and others, that the infant mortality rate per 1,000 births for the United States as a whole was about 124. Comparing this estimate with the computed rates for the foreign countries given in the preceding table, it will be seen that the rate of infant mortality in the United States is lower than in such countries as Chile, Hungary, Jamaica, Prussia, Servia, and Italy; about equal to the rate for the province of Ontario and for France; higher than the rate for England and Wales, Scotland, Finland, Switzerland, and Denmark; and considerably higher than the rate for Ireland, Sweden, Norway, New Zealand, and the Australian Commonwealth.

The figures quoted in the previous table also are of value in that they show the relative position of infant mortality in the different states and sections of the United States. The states included in the registration area are arranged in an ascending order according to their infant death rates. An examination of this table at once reveals the fact that in general the lowest rates are to be found in the Western and the highest in the Eastern states, with the rates for the North-Central (or Middle-Western) states in between. Thus, the

* Figures for deaths for 1911, first year of operation of state law.

average infant death rate for the 5 Western and Mountain states included was 91, for the 6 North-Central states, 108, and for the 9 New England and Middle-Atlantic states, 149.*

The same conclusion that in 1910 infant death rates were lowest in the Western part of the registration area and highest in the Eastern, with the Middle-West in between, is also to be drawn from an examination of the following table showing the infant death rate per 1,000 population under one year of age for the larger cities of the registration area:†

Oakland, Cal.....	94.8	Dayton, Ohio.....	146.8
Seattle, Wash.	100.4	Cleveland, Ohio...	147.2
Portland, Ore.	105.3	Cincinnati, Ohio ..	149.8
Los Angeles, Cal...	110.7	Jersey City, N. J..	153.2
San Francisco, Cal.	113.6	New Orleans, La. .	154.9
Toledo, Ohio.....	125.0	Atlanta, Ga.....	155.3
Cambridge, Mass. .	126.1	Bridgeport, Conn..	155.5
St. Paul, Minn. ...	130.8	Philadelphia, Pa...	162.2
Birmingham, Ala..	133.0	Albany, N. Y.....	162.9
Louisville, Ky.....	134.0	Boston, Mass.	165.5
Denver, Col.....	134.7	Worcester, Mass...	168.0
Grand Rapids, Mich.	134.8	Kansas City, Mo..	170.4
New Haven, Conn..	134.9	Milwaukee, Wis. ..	172.0
Nashville, Tenn....	135.1	Providence, R. I...	173.7
St. Louis, Mo.....	135.8	Syracuse, N. Y. ...	176.4
Chicago, Ill.	139.5	Pittsburg, Pa.	179.6
Omaha, Neb.....	140.0	Buffalo, N. Y.....	180.9
Columbus, Ohio...	140.4	Washington, D. C.	194.6
Spokane, Wash.....	142.4	Detroit, Mich.....	204.8
Indianapolis, Ind...	144.8	Baltimore, Md....	209.6
Newark, N. J.	145.8	Richmond, Va. ...	229.3
New York, N. Y...	146.2	Fall River, Mass..	259.5
Paterson, N. J.....	146.7	Lowell, Mass.	261.0

* As only 2 of the 16 Southern states were included in the registration area in 1910, no comparison of the incidence of infant mortality in this with other sections of the country is possible.

† Bureau of the Census: Bulletin 112—Mortality Statistics, p. 24.

The average infant death rate in 1910 per 1,000 population under one year of age was 115 for the 7 Western and Mountain cities included in the table, 149 for the 14 North-Central (or Middle-Western) cities, 165 for the 7 Southern cities, 162 for the 9 Middle-Atlantic cities, and 181 for the 8 New England cities.

This study of the position of infant mortality in the United States and foreign countries shows the seriousness and world-wide significance of the problem. It also shows how the infant mortality rate varies in different parts of the civilized world. Thus, the rate has been found to be much lower in Australia than in Europe. Among the European countries it was lowest in Norway, Sweden, Ireland, and Denmark and highest in Russia, Prussia, Hungary, and Italy. Turning to a single country, the United States, and substituting the use of the infant death rate per 1,000 population under one year of age for that of the infant mortality rate per 1,000 births, the same wide variation was revealed, the ratio of infant deaths to population being considerably less in the Western than in the Eastern parts of the registration area. Further examination of the tables also showed that the ratio varies just as widely when the cities of any state or country are compared. The examination of the report of the health department of almost any city that requires the registration of births and deaths will reveal the same variation by wards—and even by blocks, if figures are given for such small areas.

This wide variation in rates of infant mortality for different countries, states, and cities constitutes a fact of fundamental importance in the study of the subject. Out of it arise questions that at once bring us face to face with the relationship between social and industrial conditions and infant mortality. Why this wide variation in the geographic distribution of infant deaths? Why is the infant death rate lower in one country than another, in certain cities of the same country than others, in certain wards of one city than in others? Why, indeed, should the death rate for little children in the first year of life so far exceed the rate for older children and adults? All of these questions require for their answer some knowledge of the causes of infant mortality and their rela-

tion to industrial, domestic, and social conditions. But with this aspect of the problem this paper cannot deal.*

The Recent Decline of Infant Mortality in Foreign Countries. Since 1881, the first year for which statistics are available for most countries, there has been a noticeable decline in infant mortality in most foreign countries and cities and, since 1900, in most of the states and large cities included in the registration area of the United States. The following table shows this decline for the principal foreign countries for which statistics are available:

PER CENT. OF DECREASE IN THE INFANT MORTALITY RATE PER 1,000 BIRTHS FOR THE PRINCIPAL FOREIGN COUNTRIES FOR WHICH STATISTICS ARE AVAILABLE BETWEEN 1881-85 AND 1906-10. (a)

Country.	1881-1885.	1906-1910.	Per Cent. of Decrease.
EUROPE			
Hungary.....	250 (b)	204	18.4
Prussia.....	207	168	18.8
Italy.....	185 (b)	153	17.3
Servia.....	157	154	1.9
Belgium.....	156	141	9.6
France.....	167	126	24.6
England and Wales.....	139	117	15.8
The Netherlands.....	181	114	31.5
Switzerland.....	171	115	32.7
Finland.....	162	117	27.7
Sweden.....	116	78	32.8
Scotland.....	117	112	4.3
Denmark.....	135	108	20.0
Ireland.....	94	94	0.0
Norway.....	99	70	29.3
AUSTRALASIA:			
The Commonwealth.....	125	78	37.6
New Zealand.....	90	70	22.2

(a) Seventy Third and Seventy Fourth Annual Reports of the Registrar General for Births, Deaths, and Marriages in England and Wales (p. xciv and pp. 105-15 respectively).

(b) Figures for 1881-85 not available: those given are for 1891-95.

The rate of infant mortality for every country included in the table declined during this period of 30 years with the single exception of Ireland where, although the rate for both periods remained the same, it was at a very low point—94 deaths

* In other recent articles the writer has discussed this question of the relation of social conditions to infant mortality. See "Infant Mortality and the Size of the Family," *QUARTERLY PUBLICATIONS OF THE AMERICAN STATISTICAL ASSOCIATION*, September, 1915; "Infant Mortality and Urban, Housing, and Living Conditions," *Journal of Sociologic Medicine*, October, 1915; "The Relation of Economic and Industrial Conditions to Infant Mortality," *Quarterly Journal of Economics*, November, 1915; and "The Influence of Prenatal Conditions on Infant Mortality," *Proceedings of the Southern Sociological Congress*, 1915.

per 1,000 births. The most notable decrease was in New Zealand and Australia. In the former the rate fell from the already low point of 90 deaths per 1,000 births to 70—a decrease of 22.2 per cent.—and in the latter from 125 to 78—a decrease of 37.6 per cent. The decline was also notable in Norway, Sweden, and Denmark and to a lesser extent in England and Wales. The absolute decrease was also great in Switzerland, the Netherlands, France, and Finland, but the rate was very high for each of these countries at the beginning of the period.*

The Registrar-general for England and Wales, from whose annual reports the preceding table was compiled, also gives figures showing the decline in the rate of infant mortality in the principal foreign cities since 1881-85. Space will not permit quotation of these in detail but the fact should be noted that in each of the cities included, with one exception (Trieste, Hungary), the rate of infant mortality declined during the period under consideration. The most notable decrease was in the three Dutch cities, Amsterdam, The Hague, and Rotterdam; the two Australian cities, Sydney and Melbourne; and the cities of Norway and Sweden, Stockholm and Christiania, in each of which the rate fell to a point below 100 deaths per 1,000 births—a record, as shown in the preceding table, also attained by each of the countries in which these cities are situated. The absolute decrease was also great in the two Prussian cities, Munich and Berlin, and the Hungarian city of Budapest, but the rate for each of these cities was very high at both the beginning and the end of the period.

The Decline in Infant Mortality in the United States. Unfortunately no series of infant mortality rates at all comparable with those just shown for foreign countries can be presented

* In view of the fact that, as has been frequently pointed out, the *apparent* decline in the rate of infant mortality in any country in a period of years may be affected by the increase in the per cent. of births which are registered, the figures given in the table may not in all cases be strictly comparable. For instance, if in three countries, in each of which the proportion of births registered in 1881 was 90 per cent., it should happen that the proportion registered should gradually increase in each *but unequally* so that in the first 92 per cent. of the births which occurred in 1910 were registered, and in the second 95 per cent., and in the third 99 per cent., the decline in the rate of infant mortality between these two years would not be strictly comparable unless the factor of varying perfection in birth registration were allowed for. This difficulty probably is not of sufficient importance to require its consideration here even if sufficient material bearing on the comparative efficiency of birth registration in foreign countries in the last thirty years were available.

for the United States. Figures are available, however, for Massachusetts and Boston for the same period, 1881-85, to 1906-10 and for three later years, 1911-13. Also, the per cent. of decrease in the infant death rate per 1,000 population under one year of age between 1900 and 1911 has been calculated by the Bureau of the Census for the registration area and the larger registration cities. The following table shows the decline in the infant mortality rate for Massachusetts and Boston since 1881 and the per cent. of decrease in the rate between 1881-85 and 1909-13:

PER CENT. OF DECREASE IN THE INFANT MORTALITY RATE PER 1,000 BIRTHS FOR THE COMMONWEALTH OF MASSACHUSETTS AND THE CITY OF BOSTON BETWEEN 1881-85 AND 1909-13. (a)

Years.	Massachusetts.	Boston.
1881-85.....	160	186
1886-90.....	161	178
1891-95.....	161	167
1896-1900.....	153	151
1901-05.....	138	138
1906-10.....	133	133
1909-13 (b).....	121	120
Per cent. of decrease.....	24.4	35.5

(a) Compiled from the Massachusetts annual reports on births, deaths, and marriages and the annual reports of the Health Department of Boston.

(b) Figures for five year period are not available.

It will be noted that the infant mortality rate in this period of thirty-three years decreased over 24 per cent. in Massachusetts and about 36 per cent. in Boston. It will also be noted that the decrease was especially marked during the past few years.

The nearest approach to an accurate determination of the position of infant mortality in the other states and cities of the United States is to be found in a table recently presented by the Bureau of the Census, and herewith reproduced in part, which shows the per cent. of decrease in the infant death rate per 1,000 population under one year of age between the census year 1900 and the calendar year 1911 for the states and large cities of the registration area. It should be noted, however, that the rates given in this table are infant death rates calculated upon the basis of infant deaths to 1,000 population under one year of age and not according to the usual method of the ratio of deaths to 1,000 births.

PER CENT. OF DECREASE IN THE INFANT DEATH RATE PER 1,000 POPULATION UNDER 1 YEAR OF AGE BETWEEN THE CENSUS YEAR 1900 AND THE CALENDAR YEAR 1911 FOR THE STATES INCLUDED IN THE REGISTRATION AREA IN 1900 AND FOR CITIES OF 400,000 POPULATION OR OVER. (a)

Area.	Census Year: 1900.	Calendar Year: 1911.	Per Cent. of Decrease.
States included in the registration area in 1900 (b)	159.3	129.5	19
Rhode Island.	197.9	138.6	30
Massachusetts.	177.8	143.3	19
New Hampshire.	172.0	150.3	13
New Jersey.	167.4	131.5	21
New York.	159.8	128.8	19
Connecticut.	156.8	130.9	17
Maine.	144.1	110.9	23
Vermont.	122.1	102.0	16
Michigan.	121.3	111.4	8
Cities of 400,000 population or over in 1910. (c)			
Baltimore.	235.1	189.2	20
Philadelphia.	201.9	141.9	30
Detroit.	201.2	168.8	16
Boston.	194.1	160.9	17
New York.	189.4	130.6	31
Cleveland.	185.5	123.7	33
Pittsburg.	179.8	141.4	21
St. Louis.	162.4	123.8	24
San Francisco.	152.2	104.8	31
Buffalo.	150.9	140.6	7
Chicago.	146.6	123.3	16

(a) Twelfth Annual Report of the Bureau of the Census on Mortality Statistics for the year 1911, p. 24.

(b) Includes District of Columbia.

(c) Space does not permit the quoting of rates for smaller cities.

From this table it will be noted that in this period of 11 years the ratio of infant deaths to 1,000 population under one year of age decreased nearly one fifth (19 per cent.) in this group of registration states. The largest decrease shown in the rate for any of the states was in that for Rhode Island (30 per cent.) and the least in that for Michigan (8 per cent.). In all the cities included in the table the infant death rate also showed a decline—ranging from 33 per cent. in Cleveland to 7 per cent. in Buffalo. The fact that this comparison relates to only two individual years and that complete returns of deaths of infants under one year of age may not always have been made, coupled with the fact that the number of infant deaths per 1,000 population under one year of age does not furnish as satisfactory a basis for the study of infant mortality as the number of such deaths per 1,000 births, tends to diminish somewhat the value of the figures given in

the table. Yet, in spite of these limitations, these figures, taken in conjunction with those previously given for Massachusetts and Boston, show that in all probability there has been a marked reduction in infant mortality in this country in recent years.*

The Decline in the Infant Mortality Rate Compared with that in the General Death Rate for All Ages. The extent of the decline in the mortality rate for infants under one year of age can not be fully appreciated until it is compared with the decline in the death rate for other age periods. The following table compares the decline in the infant mortality rate shown in preceding tables with the decline in the general death rate for all ages during the same periods:

PER CENT. OF DECREASE IN THE INFANT MORTALITY RATE PER 1,000 BIRTHS AND IN THE GENERAL DEATH RATE FOR OF ALL AGES PER 1,000 POPULATION BETWEEN 1881-85 AND 1891-95 AND BETWEEN 1896-1900 AND 1906-10, FOR THE PRINCIPAL FOREIGN COUNTRIES. (a)

Country.	Per Cent. of Decrease Between 1881-85 and 1891-95		Per Cent. of Decrease Between 1896-1900 and 1906-10	
	General Death Rate.	Infant Mor- tality Rate.	General Death Rate.	Infant Mor- tality Rate.
Hungary.....	3.9	—	10.4	6.8
Prussia.....	10.2	1.0	17.6	16.4
Italy.....	6.6	—	8.3	8.9
Servia.....	+15.2	+8.7	+35.6	3.1
Belgium.....	2.4	+4.9	+26.7	10.8
France.....	+0.4	+2.3	7.2	20.8
England and Wales.....	3.6	+7.9	16.9	25.0
The Netherlands.....	8.4	8.8	16.8	24.5
Switzerland.....	7.0	9.3	+30.4	19.6
Finland.....	7.7	10.5	8.4	15.8
Sweden.....	5.1	11.2	11.2	22.8
Scotland.....	3.1	+7.1	10.6	13.2
Denmark.....	+1.1	+2.2	16.5	18.2
Ireland.....	+2.7	+7.8	4.4	11.3
Norway.....	2.3	1.0	11.5	27.1
New Zealand.....	7.3	3.3	+1.0	12.5
The Australian Commonwealth.....	15.3	12.8	15.7	30.4

A plus sign (+) denotes an increase.

(a) Compiled from the Seventy Third and Seventy Fourth Annual Reports of the Registrar General for Births, Deaths, and Marriages in England and Wales for the years 1910 and 1911. The Twelfth Annual Report of the Bureau of the Census on Mortality Statistics for 1911 quotes in detail the general death rates from which the per cents. of decrease in this table were compiled.

* This is the conclusion arrived at in the Twelfth Annual Report of the Bureau of the Census on Mortality Statistics for the year 1911, p. 24, and expressed in the following words: "There has been a marked reduction in the infant death rate in recent years."

The first thing to be noted upon examination of the above table is the much greater per cent. of decrease in both the general death rate and the infant mortality rate in the last than in the first half of this period of thirty years. Thus, from 1881-85 to 1891-95 the infant mortality rate decreased in only 8 of the 15 countries for which rates could be obtained, while from 1896-1900 to 1906-10 it declined in every country included in the table. Moreover, the average per cent. of decrease for all countries in the latter period was twice as great as in the former. The same variation is also shown in the decline of the general death rate in the two periods but to a somewhat lesser extent.

By comparing the extent of the decline in the infant mortality rate with that in the general death rate it will be seen that in the first half of the period the greater decline occurred in the general death rate, while during the second half the greater decline occurred in the infant mortality rate. Thus, from 1881-85 to 1891-95, a greater per cent. of decrease in the infant mortality rate occurred in only 4 of the countries included in the table, while from 1896-1900 to 1906-10 a greater per cent. of decrease failed to occur in only 2 countries.

A similar comparison extending over the same periods can be made for Massachusetts, and it shows the same results. Thus, from 1881-85 to 1891-95, the general death rate for Massachusetts decreased 0.5 per cent. and the infant mortality rate increased 0.6 per cent., while during the period from 1896-1900 to 1906-10 the former rate decreased 10.5 per cent. and the latter 13.1 per cent.

That this greater decline in the infant mortality rate than in the general death rate during recent years is probably typical for this country is shown in the following table, which compares the per cent. of decrease between 1900 and 1911 in the general death rate and the infant death rate for the states included in the registration area in 1900:

PER CENT. OF DECREASE IN THE INFANT DEATH RATE PER 1,000 POPULATION UNDER 1 YEAR OF AGE AND THE GENERAL DEATH RATE FOR ALL AGES PER 1,000 POPULATION BETWEEN 1900 AND 1911, FOR THE STATES INCLUDED IN THE REGISTRATION AREA IN 1900. (a)

State.	General Death Rate.	Infant Mortality Rate.
All States (b).....	14	19
Rhode Island.....	25	30
Maine.....	13	23
New Jersey.....	17	21
New York.....	14	19
Massachusetts.....	17	19
Connecticut.....	15	17
Vermont.....	9	16
New Hampshire.....	13	13
Michigan.....	11	8

(a) Twelfth Annual Report of the Bureau of the Census on Mortality Statistics for the year 1911, pp. 22 and 25. The general death rates are "corrected on the basis of the standard million of England and Wales."

(b) District of Columbia included in both rates and Indiana in the general death rate in addition to the states mentioned.

During this period of 11 years a greater decline in the infant death rate than the general death rate for all ages occurred in all of the 9 states included in the above table except 2, New Hampshire and Michigan. In the former the decline in the two rates was exactly equal. All evidence seems to point, therefore, to the conclusion that the decline in the infant mortality rate during the last 10 or 15 years has been greater than that in the general death rate for all ages.

Before leaving this subject it will be advisable to compare the decline in mortality by age. This is possible from the figures given in the following table comparing the per cent. of decrease in the death rate for persons of different ages between 1900 and 1911 for the group of registration states as constituted in 1900:

PER CENT. OF DECREASE IN THE DEATH RATE PER 1,000 POPULATION FOR CERTAIN AGE GROUPS BETWEEN 1900 AND 1911, FOR THE STATES INCLUDED IN THE REGISTRATION AREA IN 1900. (a)

All ages.....		13
Under 1 year.....	22	25 to 34 years..... 23
1 to 4 years.....	35	35 to 44 years..... 9
5 to 9 years.....	32	45 to 54 years..... 3
10 to 14 years.....	27	55 to 64 years..... +4
15 to 19 years.....	27	65 to 74 years..... +3
20 to 24 years.....	26	75 years and over..... 0

A plus sign (+) denotes an increase.

(a) Twelfth Annual Report of the Bureau of the Census on Mortality Statistics, p. 22.

An examination of these figures shows that the death rate for all age groups under 55 decreased between 1900 and 1911. The greatest decrease was for the age group 1 to 4 years, the per cent. of decrease falling off with each succeeding age group until the period from 55 to 64 years was reached, this and the next group showing a small increase. The death rate above 75 years was practically the same in each period. The per cent. of decrease in the mortality of the first year of life was noteworthy (22) but it was exceeded by that of the years of both childhood and adolescence, being about equal to that for the age group 25 to 34 years and greater than that for all succeeding groups.

It has thus been shown that since 1881 the rate of infant mortality has been declining in practically all European countries for which statistics are available, in the Australian Commonwealth and New Zealand, and in Massachusetts and Boston in this country. This decline in infant mortality has been especially marked in the last twelve or fifteen years during which period it has practically everywhere exceeded the decline in the general death rate for all ages. It has also been shown that between 1900 and 1911 a marked decline in the infant death rate per 1,000 population under one year of age occurred in the states and large cities of the registration area. Here, too, the decline in the infant death rate was with one or two exceptions found to be greater than that in the general death rate. On comparing the per cent. of decrease in the death rate for infants under one year of age with that for other ages it was found that the decline in infant mortality was less than that for children or young persons under 25 years of age but about equal to that for persons in the age group 25 to 35 years and greater than that for persons over 35. It appears, therefore, that the decline in the infant death rate has in general been greater than the decline in the adult death rate; but the decline in the infant death rate has not been as great as the decline in the death rate for persons in the years of childhood and adolescence.

II.

THE INFLUENCE OF PRENATAL CONDITIONS ON
INFANT MORTALITY

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1915, pp. 176-190.*

II.

THE INFLUENCE OF PRENATAL CONDITIONS ON INFANT MORTALITY

THE term "infancy" is usually defined as that period extending from birth to the end of the first year of life, and the problem of infant mortality as the excessively high ratio of deaths to births during this period. It is obvious, however, that any study of the causes of infant mortality cannot be confined solely to the period of infancy. Children come into the world as the result of a long period of fetal, embryonic, and germinal development, and their ability to withstand the vicissitudes of life and to adjust themselves to their new environments is largely determined by the conditions surrounding them in their prenatal existence. Just as the adult carries with him into manhood the effects of the conditions with which he came into contact in infancy and childhood, so the new-born infant brings with him into postnatal life the results of a long period of prenatal and even preconceptual development; and just as in accounting for adult mortality careful consideration must be given to the period of infancy and childhood, so in any attempt to account for the problem of infant mortality a careful study must be made of the conditions surrounding the infant in its intra-uterine and preconceptual development.

There are, then, two distinct periods concerned in the problem of infant mortality—the postnatal, or period of infancy proper, and the prenatal, or period before birth. Each of these is in turn further subdivided, as is shown in the following chart:

SUBDIVISIONS OF THE PRENATAL AND POSTNATAL PERIODS OF INFANT DEVELOPMENT

I. The Prenatal Period.

1. The Germinal Period before Conception.
2. The Intra-uterine Period.

- a. The Embryonic Period. (The first three months of intra-uterine life.)
- b. The Fetal Period. (From the end of the embryonic period to birth.)

II. The Postnatal Period.

- 1. The Period of Early Infancy. (The first three months of life.)
- 2. The Period of Later Infancy. (The last nine months of the first year of life.)

To understand the causes of infant mortality it is necessary to keep these periods of infant development clearly in mind and to take into account the character of the parental stock that is united at conception, the circumstances through which the infant's organism passes before birth while in the mother's womb, the conditions of life to which it must adjust itself immediately after birth, and the influences which affect its growth during the later months of infancy after the adjustment to the demands of life has once been made.

During the period of early infancy, after the child has been expelled from the mother's womb by birth, and adaptation and adjustment to the new environment begun, its survival is determined not only by the conditions with which it then comes into contact but also by the strength, adaptability, and fitness to meet the normal demands of life which it may have developed in the long period of germinal, embryonic, and fetal growth. The infant may be born already diseased or malformed, it may have acquired before birth a predisposition to disease, it may be congenitally so weak that it is unable to cope with its new environment, its new temperature, and its new method of receiving food and air. The failure of such children to make the necessary adjustment to vital conditions and to survive creates to a very large extent, as will be shown later, the mortality of the early weeks and months of infancy.

THE INFLUENCE OF PRENATAL CONDITIONS ON INFANT MORTALITY PARTLY SOCIAL AND PARTLY HEREDITARY

Closer examination of the chart will bring out the part played by heredity and by environmental conditions in determining the extent of the influence of prenatal conditions on infant mortality. In the broadest sense the term "heredity," or the transmission of physical or mental characters from parent to offspring, may be said to include all that is implied in the term, "the prenatal factors of infant mortality." On the other hand, this use of terms does not emphasize sufficiently the importance of the environmental influences which affect the growth and development of the infant's organism in the intra-uterine period between conception and birth. Better is it to say that the prenatal factors of infant mortality are the product of both heredity and the environment working together—the product of heredity in that it is through this process that the organism is brought into existence, and the product of the environment in that environmental influences acting through the mother affect the development of the infant's organism from conception to birth.

The prenatal influence of the environment may be seen, for instance, in the influence of the nutrition of the mother during pregnancy on the rate of infant mortality. As the developing organism in the uterus is entirely dependent for its food upon its mother, it is to be expected that the rate of infant mortality will be affected by the character of the food she obtains during pregnancy, as well as by the kind which the infant obtains directly after its birth. Dr. Herman Schwarz, in the first annual report of the New York Free Outdoor Maternity Clinic, shows how this occurred in the case of 2,540 infants whose mothers came under the observation of the clinic during the first nine years of its work.* Thus, the rate of mortality was 144 deaths per 1,000 births among the infants whose mothers' food was poor, 124 where it was fair, and only 62 where it was good.

In the same way the character of the work which the

*1910, p. 45.

mother does during the later stages of pregnancy and the amount of rest she takes before confinement have an important prenatal influence on infant mortality. To quote from a recent writer on this subject: "A number of investigations have shown that the state of the infant at birth is greatly affected by the conditions under which the mother has lived during the previous months. The children of working women who are able to rest during the later months of pregnancy are to a marked degree larger and finer than the children of working women who have pursued their occupation to within a short time of their confinement, even though the women who thus pursue their work may be entirely healthy and robust. Moreover, such rest is a powerful agent in preventing premature birth. This is an important matter, for . . . the child who is born before its time comes into the world in a relatively unprotected state, and is unduly liable to perish or else to lead a permanently enfeebled life. . . . Opportunity for completing its development is of immense and lifelong importance to the newborn infant, while the rest is also of benefit to the mother, who cannot with impunity stand the double strain of work and of nourishing the future child within her. Yet the importance of such rest for women in its bearing on the elevation of the race and the lightening of social burdens is still understood by few."*

Moreover, although this aspect of the question is not often emphasized, this adverse effect of the mother's work during the later stages of pregnancy may result from the work of mothers who are employed only in the performance of their own household duties, as well as from the work of those who are employed in gainful occupations. While it is true that the prenatal effect of gainful employment on infant mortality is much more serious in most cases than the effect of work which the mother does in her own home as a part of her household duties, it does not follow that all the emphasis should be laid upon gainful employment. All mothers need rest and care before confinement and any program for

*Havelock Ellis, "The Problem of Race Regeneration." London, 1911, pp. 18-19.

the control or reduction of the influence of prenatal conditions on infant mortality should include within its scope better care for all classes of expectant mothers, whether rich or poor, and whether employed in gainful or non-gainful occupations.

PREVENTIVE METHODS: THE CONTROL AND REDUCTION OF THE
INFLUENCE OF PRENATAL CONDITIONS ON INFANT
MORTALITY

The distinction between the influence of heredity in the strict sense and of the environment during the prenatal stage of infant development has been clearly drawn in the campaign for the prevention of infant mortality. On the one hand are the efforts that are being made to prevent the marriage of the unfit, the diseased, and the incapable, and on the other the efforts that are being made to improve the conditions under which expectant mothers must live and to raise the standards of "mother-care" during pregnancy. The former efforts to control the influence of hereditary tendencies usually have primarily in view the improvement of the race stock, the conservation of a desirable strain, or the elimination of an undesirable strain, while in the latter efforts to control the conditions under which the infant's organism develops between conception and birth the chief end in view is to enable each child that is to come into the world to bring with it unimpaired all the capacities that heredity bestowed upon it at conception and to give to its organism a fair opportunity to develop between conception and birth. This form of prenatal work is simply an effort to conserve and protect the developing organism before birth in the same way that we have long felt that the growing child should be protected after birth. As one writer has expressed it, "it is not enough to begin the social care of the child at birth. It has been living for nine months before birth, and it is now recognized that the conditions of its life must be guarded by society during that supremely important formative period." We must recognize the fact that from the standpoint of infant mortality the trouble is by no means only with the fitness of the parents for bringing children

into the world; too frequently it is with the fitness of the environment in which the mother must live during pregnancy.

This is not the place for an account of the specific methods that have been proposed or which are now being applied in the reduction and control of the influence of prenatal conditions on infant mortality. The fact must be kept clearly in mind, however, that the importance of this aspect of the problem is not generally realized. One distinguished authority has gone so far as to say that "to-day the dregs of the human species—the blind, the deaf-mute, the degenerate, the nervous, the vicious, the idiotic, the imbecile, the cretin, and the epileptic—are better protected than pregnant women."* This is, of course, an extreme statement, but it is probably true that these dependent and degenerate classes do receive more care and *especial consideration because of their condition than expectant mothers do because of theirs*. Expectant mothers, *because they are expectant mothers*, should receive more care and consideration than they are given to-day.

THE INFLUENCE OF PRENATAL CONDITIONS ON THE MORTALITY OF INFANTS IN THE EARLY WEEKS AND MONTHS OF LIFE

An idea of the extent of the influence of prenatal conditions on infant mortality can be obtained from the following figures comparing the per cent of infant deaths which occurred in the registration area of the United States in 1910 at certain age periods:†

Under 1 week.....	23.5
1 week to 1 month.....	14.1
1 month to 3 months.....	18.3
3 to 6 months.....	19.3
6 to 9 months.....	14.1
9 to 12 months.....	10.7

*Quoted in Havelock Ellis's "The Problem of Race Regeneration." London, 1911, p. 20. The writer does not cite the author of the statement.

†U. S. Bureau of the Census: "Mortality Statistics," 1910, p. 533.

Thus, the deaths of infants are not distributed evenly throughout the first year of life, 38 per cent occurring during the first month and over half during the first three months. Moreover, the number of children dying during the first week of infancy was almost exactly equal to the number dying during the entire last six months of the period. In this truly astounding fact we see the influence of prenatal conditions upon infant mortality. The failure of such a large proportion of the babies who are born to survive more than a few weeks or months can be ascribed only to the influence of conditions affecting them before birth, during what we have called the prenatal period of infant development.

THE INFLUENCE OF PRENATAL CONDITIONS ON THE INFANT DEATH RATE FROM THE DISEASES OF EARLY INFANCY

But the influence of prenatal conditions on infant mortality is also to be seen in the large proportion of deaths of infants which result from premature birth, congenital debility, congenital malformations, and other causes of death having their origin in conditions affecting the infant's organism before birth. It will therefore be necessary to examine the causes of the deaths of the 154,373 babies who died in the registration area of the United States in 1910. The following figures compiled from Bulletin 109 of the Bureau of the Census show the per cent of the total number of infants who died from each cause:

Diseases of the digestive system.....	32.1
Diseases of early infancy (including premature birth, 13.1 per cent, congenital debility, 7.8, and injuries at birth, 2.4)....	25.5
Diseases of the respiratory system (including broncho-pneumonia, 6.9, pneumonia, 5.5, and acute bronchitis, 2.7).....	15.8
General diseases (including all forms of tuberculosis, 1.6, syphilis, 1.1, and whooping cough, measles, scarlet fever, diphtheria, and croup, 4.0).....	9.2
Diseases of the nervous system (including convulsions, 2.6, and meningitides, 1.5)	5.5
Congenital malformations	4.9
All other causes.....	7.4

It will thus be seen that 32 per cent of the infant deaths occurring in this representative year in the registration area of the United States were reported as being caused by the diseases of the digestive system, 26 per cent by the diseases of early infancy, and 16 per cent by the diseases of the respiratory system—nearly 74 per cent in all being reported as due to these three groups of causes. Before drawing any conclusions as to the significance of these facts it will be necessary to inquire in more detail as to what age periods of infancy are most affected by each of these great causes of infant deaths. This is possible from the following data taken from the annual report of the health department of the city of Boston for 1910:* “Fifty-five per cent of the deaths of infants under three months of age which occurred in Boston during this representative year were reported as having been caused by the diseases of early infancy (especially premature birth, congenital debility, and injuries at birth), and 9 per cent by a similar cause, congenital malformations, while the deaths reported under all these headings combined caused only 11 per cent of the total number of deaths which occurred during the last nine months of infancy. In comparison the diseases of the digestive system were reported as causing 16 per cent of the deaths of the first three months of infancy, almost half of those of the second three months, 35 per cent of those of the third three months, and 40 per cent of those which occurred during the last three months of the period. In a similar manner the deaths from the diseases of the respiratory system increased from 11 per cent during the first three months of infancy to 26 per cent during the last, and those from general diseases from 5 per cent during the first three months to 19 per cent during the last three months of the period.”

In other words, congenital malformations and the diseases of early infancy are the prime factors in the mortality of the first three months of infancy and the diseases of the digestive and respiratory systems the prime factors

*Such figures are not available for the registration area of the United States.

in the mortality of the last nine months. What, then, is the nature of these diseases which so completely dominate the mortality of the early weeks and months of life and what are the conditions determining their influence?

The diseases of early infancy comprise one of the thirteen classes of causes of death in the international classification. Within it are included those infants who die of such causes as congenital debility, premature birth, injuries at birth, and the like. The group also includes such causes of death as "marasmus," "inanition," "wasting disease," "constitutional weakness," "congenital malnutrition," and the like. It is only necessary for the lay reader, even if he has but a small knowledge of the meaning of medical terms, to glance at these titles to see that practically all of them imply that the child was not born with sufficient strength to withstand the normal demands of life for more than a few weeks or months at most.* Clearly the deaths of infants so soon after birth as a result of such causes—whether they grow out of prematurity of birth, an accident or injury at birth, or to simple congenital inability to survive—must be due to something besides the influence of the environment into which they are born. It is not the postnatal environment or its diseases which really bring about their death, but their absolute unfitness to withstand the normal demands of life itself. Such deaths are clearly attributable to prenatal conditions, to heredity, and to influences affecting the child's organism before birth.

THE EXTENT OF THE INFLUENCE OF PRENATAL CONDITIONS ON INFANT MORTALITY

There are two other causes of death which are so closely associated in origin with the diseases of early infancy, being

*The only exception is in the case of lack of care; but since the number of infant deaths reported as due to this cause is so small, the exception is of little consequence. In Boston only two and in the registration area of the United States only 132, or in each case only about one-tenth of one per cent of the total number of infant deaths in 1910, were reported as due to this cause.

also the result of conditions affecting the child's organism before birth, that their influence must also be counted with them in order to fully estimate the influence of prenatal conditions on the rate of infant mortality—congenital malformations and syphilis, the former including infant deaths resulting from some deformity acquired by the child's organism before birth (such as congenital intestinal obstruction, harelip, malformation of the brain or heart, and the like), and the latter in the great majority of cases resulting from syphilitic infection before birth. In 1910 congenital malformations were reported as causing 5.3 per cent of the deaths of infants under one year of age in Boston and 8.6 per cent of those under three months, while syphilis was reported as causing 1.0 per cent of the deaths under one year and 1.2 per cent of those under three months of age.

Combining the deaths from these two causes with those from the diseases of early infancy, it will be seen that at the very least 35 per cent of the deaths occurring during the first year and 60 per cent of those during the first three months of life and a much larger proportion still of those which occur during the first month are *largely* the result of prenatal conditions. This proportion, astounding as it may seem, cannot be regarded as much too large, because any infants included whose deaths may not have been "largely due" to conditions affecting their organisms before birth are probably compensated for by the returns of other infant deaths actually due to congenital debility, syphilis, congenital malformation, or premature birth, under some other heading.

But even according to the most conservative estimate the influence of prenatal conditions on infant mortality must be regarded as of great importance not only through its contribution to the death rate from chief causes but from contributory causes as well; and not only upon the rate of infant mortality but on child mortality also; for many children, although their chances of life in the period of infancy are greatly reduced by congenital influences, still survive until after the end of the first year of life, thus tending to increase the death rate for later years.

COMPARISON OF THE RECENT DECLINE IN THE INFLUENCE OF
PRENATAL AND POSTNATAL CONDITIONS ON
INFANT MORTALITY

During recent years the infant death rate for the first weeks and months of infancy has not declined as rapidly as the rate for the latter and middle months of the period. It is necessary to examine the actual figures in some detail since, as will be clear from the discussion in the previous section, they indicate that the influence of the prenatal factors of infant mortality is not decreasing as rapidly as that of the postnatal factors, or as rapidly as the infant mortality rate.

The following table shows the per cent of decrease in the infant mortality rate per 1,000 births for England and Wales between 1888-92 and 1908-11 by age:

Years	Under 1 Year	Under 3 Months	3 to 6 Months	6 to 12 Months
1888-92.....	145.4	70.5	29.5	45.4
1893-97.....	153.4	73.7	32.0	47.7
1898-1902.....	152.2	74.3	32.3	46.1
1903-07.....	131.1	67.3	25.9	37.9
1908-11.....	116.1	62.1	21.9	32.1
Per Cent of Decrease....	20.2	11.9	25.8	29.3

An examination of this table shows that in England and Wales during the twenty-four years under consideration the rate of infant mortality for the last six months of the first year of life declined about 29 per cent and that for the second three months about 26 per cent, while the rate for the first three months declined only about 12 per cent. The registrar-general for England and Wales in his annual reports on births, deaths, and marriages from which the above figures were compiled also gives similar data for the city of London. The decline in the rate of mortality for the first three months of infancy was only 16.4 per cent, while the decline for the second three months was 29.1 and 31.6 per cent respectively. Thus the decline in the infant mortality rate for the first three months of age—the period so

largely influenced by the prenatal factors of infant mortality—was in England and Wales less than half and in London somewhat more than half as great as that for either the second three months or the last six months of infancy. Similar figures are available for this country only for the last four years. The following table shows for 1910-11 and 1912-13 the average annual number of infant deaths in the registration area at certain age periods and in addition the crude death rate for each age period per 100,000 population of all ages.* So crude a rate is, of course, open to serious objections; but it is better than nothing, and is therefore included.

Age at Death	Average Annual Number of Deaths		Crude Death Rate	
	1910-11	1912-13	1910-11	1912-13
Under 1 year.....	151,848	153,446	268.4	248.0
Under 1 month.....	60,491	66,472	107.0	107.5
1 to 3 months.....	27,198	26,496	48.1	42.8
3 to 6 months.....	28,062	26,520	49.6	42.9
6 to 9 months.....	20,452	19,016	36.2	30.7
9 to 12 months.....	15,645	14,940	27.7	24.2

An examination of the table shows that during the last four years the death rate per 100,000 total population for the first month of infancy remained practically stationary. The rate for each of the later age periods decreased; but the decrease in the rate for the period 1 to 3 months (11 per cent) was less than that for either of the later periods (13 to 15 per cent).

This same tendency may also be illustrated with figures for Boston. Thus during the same period the infant mortality rate per 1,000 births for the first month of infancy

*Compiled from the Eleventh to the Fourteenth Annual Reports of the Bureau of the Census on Mortality Statistics. The four years here considered do not furnish a sufficiently long period to establish independently a definite conclusion as to the shifting of the age incidence of infant mortality in this country, but when they are supplemented by the figures already given for England and Wales and London they may be regarded as furnishing a fairly adequate indication of existing tendencies.

remained practically stationary (46.9 in 1910-11 and 46.0 in 1911-12); while for each subsequent age period it decreased, the decline in the rate for the age period 1 to 3 months (20 per cent) being greater than that for any other age period (11 per cent for the period 3 to 6 months, 15 for the period 6 to 9, and 19 for the period from 9 to 12 months).* The marked decline in the rate for the period from 1 to 3 months is especially interesting, since it may be partly due to the efficient "prenatal work" with expectant mothers that has been carried on in Boston throughout the four years. Perhaps if this work had not been done the decline in the rate for this age group would have been no larger than that which occurred in the registration area.

Thus such figures as are available in this country reveal tendencies which are in exact accord with those shown by figures extending over a much longer period for England and Wales and for London. Now if this conclusion be accepted its significance is not difficult to discover, for, as has already been shown, the mortality of early infancy, and particularly the mortality of the first month, is largely determined by deaths from causes growing out of influences affecting the child's organism before birth—or, in other words, from the influence of prenatal conditions—while the mortality of the later months of infancy is largely determined by the influence of conditions affecting the child's organism after birth—or, in other words, to the influence of postnatal conditions. Any changes in the incidence of mortality in these periods, therefore, is an indication that similar changes have occurred in the relative influence of the prenatal and postnatal factors of infant mortality. *The conclusion seems well founded that during recent years the influence of prenatal conditions on infant mortality has not declined as rapidly as the influence of postnatal conditions.*

In accounting for this stability in the rate of mortality for the early weeks and months of infancy, especial consideration must be given to the fact that deaths in the first

*These figures were compiled from the Annual Reports of the Health Department of Boston.

weeks and months of life are not so readily affected by the action of preventive methods as those in the later months of infancy, and that the influence of the prenatal factors of infant mortality are not as easily controlled as the influence of the postnatal factors. Yet, while this is true, it should not be forgotten that not until the last few years were the methods employed in bringing about a reduction in the general death rate for all ages, as well as in the rate for the middle and later months of infancy, such as could be expected to have much influence on prenatal conditions. The movement for the improvement in the water and milk supply and for the elimination of contagious and infectious diseases, for instance, both of which have been important factors in the decline of the death rate for adults and young children as well as of infants over two or three months of age, have had in comparison only an incidental effect on the mortality rate for the first two or three months of life. In the campaign for the direct purpose of preventing infant mortality for a long time attention was confined primarily to the prevention of infectious and contagious diseases and to the reduction of the death rate from digestive diseases. It was not until a comparatively few years ago that any organized, systematic efforts were made to lessen the number of infant deaths brought about by the action of prenatal conditions. Milk stations, valuable as they have been, were not important factors in "prenatal infant mortality" until they became "infant welfare stations" and added prenatal instruction to their work and prenatal nurses to their staffs.

The method that has been adopted and found most effective in coping with this phase of infant mortality is, as has already been shown, what is called prenatal work with expectant mothers. It cannot be described here more fully than has been done already except to say that it is simply an attempt to give direct instruction to expectant mothers at different times during pregnancy, usually as early as possible before delivery, in the proper care of themselves and their baby to come. This kind of work is usually carried on in the poorer quarters of the city, but this is not the only

or even the most important phase of "prenatal care." The increasing interest that is being taken in the whole question of the effect of prenatal conditions on mortality and the increasing emphasis that is being laid upon the prenatal care of all mothers regardless of their economic or social condition will have and is having an important influence on the problem. It is to be hoped and expected, therefore, that the next five or ten years will show a greater decline in the influence of prenatal conditions on infant mortality than has occurred in previous years.

III.
INFANT MORTALITY AND THE SIZE OF THE
FAMILY

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III.

INFANT MORTALITY AND THE SIZE OF THE FAMILY.

The influence of the birth rate on the rate of infant mortality has been frequently pointed out. Newsholme in his recent report to the English Local Government Board notes "the connection often observed between a high birth rate and a high rate of infant mortality."* Phelps, also, in his study of *Infant Mortality and Its Relation to Women's Employment*, states that in Massachusetts cities a "more direct relationship exists between infant mortality and the birth rate . . . than infant mortality and the employment of women," although in neither case, as his figures bring out, is the relationship invariable or even close.† The Director of the Statistical Service of France, on the other hand, has shown from an investigation made in 1907 by the Superior Council of Statistics that whatever relationship there may be between the birth rate and the infant mortality rate in cities or countries there is a very close relationship between the birth rate in families—or, what is practically the same, a close relationship between the size of the family and the rate of child mortality. It is not possible from the figures given in his study to separate the statistics for infants under one year of age, but by considering only the period from 1901–1907 it will be possible to secure a group with a maximum age at death of six years. This is done in the following table, which shows the mortality rate for infants whose fathers were employed in the public service of France according to their order of birth, or, in other words, according to the number of previous births in the family:

*Great Britain, Local Government Board, Supplement to the Thirty-ninth Annual Report, p. 49.

†Phelps, Edward B., "Infant Mortality and Its Relation to Women's Employment—A Study of Massachusetts Statistics." In Volume XIII, Part I, of the Bureau (Now Department) of Labor's Report on Condition of Women and Child Wage Earners in the United States, p. 38.

TABLE I.

MORTALITY RATE PER 1,000 BIRTHS AMONG CHILDREN WHOSE FATHERS WERE EMPLOYED IN THE PUBLIC SERVICE OF FRANCE CLASSIFIED ACCORDING TO ORDER OF BIRTH, 1901-1907. (a)

Order of Birth.	Number of Births.	Infant Mortality Rate.
First born.....	25,102	113.7
Second born.....	21,384	121.5
Third born.....	14,675	139.4
Fourth born.....	9,750	145.5
Fifth born.....	6,430	165.2
Sixth born.....	4,251	173.2
Seventh born.....	2,783	186.5
Eighth born.....	1,842	204.5
Ninth born.....	1,215	187.7
Tenth born.....	826	236.2
Eleventh born.....	455	248.4
Twelfth born and over.....	687	276.6
Total.....	89,400	138.3

(a) Compiled from Lucien March's "Some Researches Concerning the Factors of Mortality." *Journal of the Royal Statistical Society*, Vol. LXXV, Part 5, p. 519. (Cf. Appendix.)

This table shows a strikingly close relationship between child mortality and the order of birth, the rate having increased from 113.7 per 1,000 births among the first born children to 276.6 among those who were twelfth born or over.* As has just been stated the relationship shown in this table is between the order of birth and the rate of mortality for children under six years of age. The New York Free Outdoor Maternity Clinic has recently published data collected during the first nine years of its work which show the relationship between infant mortality and the number of children to which the mother has previously given birth—a classification for all practical purposes identical with that in Table I, based on the order of birth.

*The only exception to the regular variation of the mortality rate with the order of birth was in the ninth group but this is not a serious exception, as it may be due to chance.

Dr. Alice Hamilton of Hull House, Chicago, in a recent article, "Excessive Child-bearing as a Factor in Infant Mortality" (*Proceedings of the Conference on the Prevention of Infant Mortality*, New Haven, 1909, pp. 74-80), shows a similar relationship between the order of birth, or size of the family, and the mortality rate for children under three years of age. Thus, among 1,600 infants born to mothers classified according to the number of children in their family the mortality rate per 1,000 births was as follows:

4 children or less.....	118
6 children or more.....	267
7 children or more.....	280
8 children or more.....	291
9 children or more.....	303

Among the Berlin working class Hamburger's investigation has also shown how serious a cause of infant mortality large families may be. (*Kinderzahl und Kindersterblichkeit. Die Neue Generation*, August, 1909). Quoted in Havelock Ellis' "The Task of Social Hygiene," pp. 150-1. Space does not permit the quoting of his figures in full.

TABLE II.

MORTALITY RATE PER 1,000 BIRTHS FOR INFANTS BORN TO MOTHERS COMING UNDER THE OBSERVATION OF THE NEW YORK FREE OUT-DOOR MATERNITY CLINIC, CLASSIFIED ACCORDING TO THE NUMBER OF PREVIOUS CHILDREN BORN TO MOTHER. (a)

Number of Previous Children Born to Mother.	Number of Births.	Infant Mortality Rate.
Less than 4.....	1,182	77
4 to 8.....	1,064	127
8 and over.....	294	170
0.....	97	10
1.....	288	66
2.....	369	81
3.....	428	96
4.....	355	127
5.....	354	189
6.....	203	163
7.....	152	105
8.....	135	207
9.....	90	166
10 and over.....	69	275
Total.....	2,540	124

(a) Compiled from the First Annual Report of the Free Out-door Maternity Clinic, Covering the First Nine Years of the Clinic's Existence, New York, 1910: Chapter 2, Part 2, Report of the Pediatric Department with a Study of Early Infant Mortality, by Herman Schwarz, M.D., pp. 42-3.

Table II shows a very close relationship between the number of children to which the mother has previously given birth and the rate of infant mortality during the year under consideration. Thus, the mortality rate rose from 77 deaths per 1,000 births for infants born to mothers who had previously given birth to less than four children to 170 for the infants whose mothers had given birth to eight or more.*

In the investigation by the Children's Bureau of infant mortality in Johnstown, Pa., the data gathered bearing on the relationship between fertility and the size of the family and infant mortality were classified according to the order of birth; but, as has already been shown, the terms "order of birth" and "number of the mother's previous pregnancies," though not absolutely identical, may be considered as practically so for our purpose.

*The exceptions to the otherwise continuous relationship of these mortality rates with the number of children to which the mother had previously given birth which appear when, as in the lower part of the table, each group is considered separately, will be discussed in connection with a later table showing similar data gathered in the Boston investigation.

TABLE III.

MORTALITY RATE PER 1,000 BIRTHS FOR INFANTS INCLUDED IN THE JOHNSTOWN INVESTIGATION CLASSIFIED ACCORDING TO THE ORDER OF THEIR BIRTH. (a)

Order of Birth.	Number of Births.	Infant Mortality Rate.
First and second born.....	622	138.3
Third and fourth born.....	400	143.2
Fifth and sixth born.....	241	177.0
Seventh and eighth born.....	137	181.5
Ninth and later born.....	91	201.1
Total.....	1,491	149.9

(a) U. S. Children's Bureau: Infant Mortality—Results of a Field Study in Johnstown, Pa., Based on a Calendar Year, by Emma Duke. Washington, 1915, p. 51. Hereafter this report will be referred to by the briefer title—Infant Mortality: Johnstown, Pa.

Thus, in Johnstown a relationship appears to exist between fertility and the size of the family and the rate of infant mortality similar to that shown in previous tables for other investigations:*

It is obvious that in this relationship between infant mortality and the order of birth, or the number of previous children to which the mother has given birth, there are two distinct factors present—that of the size of the family in which the child lives after birth and that of fertility in its narrowest sense, including primarily the physical influence of childbearing upon the mother and upon the chances of survival of subsequent infants to which she gives birth. Better expressed, this relationship is brought about by the influence of both prenatal and postnatal conditions on infant mortality. With this in view an attempt was made in an investigation made in 1910 and 1911, by the Research Department of the Boston School for Social Workers, to take account of both of these factors and as far as possible to measure the influence of each.†

*For other figures showing the relationship between infant mortality and the order of birth in the family see—R. J. Ewart, "The Aristocracy of Infancy and the Conditions of Birth," *Eugenics Review*, Vol. III, p. 166.

†The data collected in this investigation have not been before published. A brief description of the investigation would, therefore, be desirable if space permitted. Visits were made to the homes of 2,063 infants (stillborn infants not included) who were born in 1910 in Wards 6, 8, 13, and 17 of the city of Boston. The birth and death records were copied from the files of the Registry Department of the city and the visits to the homes made by fellows in the Research Department of the School for Social Workers during the academic years 1910–1911 and 1911–1912. During the second year of the investigation this field work was supervised by the writer under the general direction of Dr. T. W. Glocker, director of the Department of Research. The writer in using these data for publication wishes gratefully to acknowledge the interest and coöperation of the fellows who made the visits to the homes, as well as that of the director of the Department of Research. He is also indebted to Dr. J. R. Brackett, Director of the School for Social Workers, for permission to use the data in this way.

The method used was that of dividing the infant deaths into two groups, those reported as due to the diseases of early infancy and congenital malformation and those reported as due to all other causes—the former group being largely dominated by prenatal and the latter by postnatal influences—and showing the relation of the number of the mother's previous pregnancies to the infant mortality rate for each group. These figures are given in the following table, which shows the infant mortality rate per 1,000 births from all causes, from the diseases of early infancy and congenital malformation, and from all other causes for infants classified according to the number of their mother's previous pregnancies.*

TABLE IV.

MORTALITY RATE PER 1,000 BIRTHS FROM ALL CAUSES, FROM THE DISEASES OF EARLY INFANCY AND CONGENITAL MALFORMATION COMBINED, AND FROM ALL OTHER CAUSES FOR INFANTS BORN IN 1910 AND VISITED IN THE HOUSE-TO-HOUSE INVESTIGATION IN BOSTON, CLASSIFIED ACCORDING TO THE NUMBER OF THEIR MOTHER'S PREVIOUS PREGNANCIES.

Number of the Mother's Previous Pregnancies.	Number of Births.	Infant Mortality Rate per 1,000 Births from—		
		All Causes.	Diseases of Early Infancy and Congenital Malformations.	All Other Causes.
Less than 5.....	1,533	120.0	29.4	90.7
6 to 9.....	475	134.7	33.7	101.1
10 and over.....	53	226.4	75.5	228.6
0.....	371	91.6	24.3	67.4
1.....	390	100.0	25.6	74.4
2.....	309	139.2	35.6	103.6
3.....	265	150.9	41.5	109.4
4.....	198	141.4	20.2	121.2
5.....	177	175.1	45.2	129.9
6.....	118	110.1	16.9	93.2
7.....	84	107.1	11.9	95.2
8 and 9.....	96	114.6	52.1	62.5
10 and over.....	53	226.4	75.5	228.6
Total (a).....	2,061	126.2	31.5	94.6

(a) Information was not obtained in two instances.

Table IV shows that the infant mortality rate varies in direct ratio with the number of the mother's previous pregnancies. Thus, among the infants born to the mothers with less than five previous pregnancies, 120 died in every 1,000

*This classification of the mothers differs primarily from that used in the preceding table quoted from the report of the New York Free Out-door Maternity Clinic in that it is based on the number of the mother's previous pregnancies including stillbirths instead of upon the number of living births excluding stillbirths and, secondarily, in that, as previous pregnancies are dealt with, the one resulting in the birth of the infant under consideration is not counted. It was adopted largely because of the difficulty of distinguishing deaths soon after birth from stillbirths.

births, in comparison with 135 among those whose mothers had had from five to ten previous pregnancies, and 226 among those who had had ten or more.* The rate of mortality from the diseases of early infancy and congenital malformation combined and from all other causes varied in the same manner, thus showing that the influence of the number of the mother's previous pregnancies on infant mortality is both prenatal and postnatal.† There are, then, two distinct factors to consider in accounting for this relationship, first, the size of the family, and second, fertility and the effect of childbearing on the health and strength of the mother and her ability to bear strong and healthy children.

*Closer examination of the lower part of the table where each pregnancy group is considered separately shows that the relationship is not entirely continuous. Thus, although the rate increases in almost continuous succession with the number of the mother's previous pregnancies up to the sixth group, it then begins to decrease and continues to do so until the group of mothers having eight and nine previous pregnancies is reached when it begins to rise again, until in the last group the highest rate of all appears. (The rate for the last group when subdivided was 171 for the infants born to those mothers having 10 or 11 previous pregnancies and 333.3 for those having 12 or more.) Practically the same condition is also seen to exist when the previous table compiled from the figures of the New York Free Out-door Maternity Clinic is examined in a similar manner.

Yet, these exceptions do not disprove, as might appear at first sight, the tendency shown when the pregnancy groups were combined. The drop in the mortality rate for the infants born to the mothers who had already had six or seven previous pregnancies is probably due to the fact that a large number of previous pregnancies not only decreases the chances of life of the infants born but, in the case of the weaker mothers, also tends to make childbearing impossible or else so perilous that it is voluntarily refrained from. It is, therefore, to be expected that the proportion of infant deaths to births will begin to decrease after the fourth and fifth pregnancy group when the weaker mothers begin to drop out of the ranks of the childbearing, thus leaving in these groups a larger proportion of strong and healthy mothers whose children will be relatively better fitted to survive.

That the low mortality rate for infants in the sixth and seventh group is due to the inclusion of a larger proportion of strong and healthy mothers in them is shown by an examination of the last two columns of the table where it will be seen that the drop in the rate from the diseases of early infancy and congenital malformations—diseases largely due to the condition of the mother during and before pregnancy—is greater than that from all other causes of death, these being largely the result of conditions arising after birth and not so directly connected with the intra-uterine period of the child's development. But even though from the standpoint of childbearing the physical condition of the mothers in the sixth and seventh groups may be so good that it renders their children relatively immune from the effects of continuous childbearing, in time, if they continue, their children will also be affected, as is shown by the renewed rise in the rate for the groups following the seventh.

These exceptions, therefore, cannot be regarded as vitiating the tendencies shown when the pregnancy groups are combined or as materially weakening the conclusion that the rate of infant mortality varies strikingly with the number of the mother's previous pregnancies and the number of children to which she has previously given birth.

†This follows from the fact—a fact that space does not permit us to submit detailed proof of—that the deaths of infants during the first week and month of life and to a lesser extent during the first three months are largely the result of conditions which affected the child's organism before birth and while it was developing in the mother's womb, or in other words largely the result of prenatal conditions, while the deaths of the later months of infancy are largely the result of conditions which affected the child after its birth, or in other words to the influence of postnatal conditions.

In accounting for this relationship between the size of the family and infant mortality several considerations should be borne in mind. It is to be expected, for instance, that congestion both as shown by the average number of persons per room and the number of persons sleeping in the bedroom with the infant will be greater among large than small families, and this was found to be true in the Boston inquiry.* Poverty, too, is generally agreed to be worse, other things being equal, where the number of small children in the family is large.† Moreover, those parents who bring into the world larger families than their neighbors deem themselves able to rear properly are frequently improvident, with a low standard of life, and in addition, are often characterized by a lack of intelligence or of sufficient knowledge of the simpler laws of hygiene. This is, of course, not true of the parents of all large families but of a sufficient number of them to raise the mortality rate for the class. In the Boston investigation it was found that of 341 mothers of whose character and intelligence the investigators felt competent to express an opinion,

*PER CENT. OF INFANTS VISITED IN THE BOSTON INVESTIGATION, CLASSIFIED ACCORDING TO THE NUMBER OF THEIR MOTHERS' PREGNANCIES WHO LIVED IN HOUSEHOLDS WHERE THE AVERAGE NUMBER OF PERSONS PER ROOM WAS LESS THAN TWO, TWO, OR THREE OR MORE.

Number Mother's Pregnancies.	Less than Two.	Two.	Three or More.	Total.	
				Per Cent.	Number.
1.....	84.6	14.0	1.4	100.0	349
2, 3 or 4.....	59.5	35.1	5.4	100.0	908
5 or 6.....	34.2	44.9	20.9	100.0	350
7 or 8.....	18.7	61.0	20.3	100.0	192
9 or more.....	17.7	61.7	20.6	100.0	141
Total.....	52.3	37.6	10.1	100.0	1,940

†Bertillon in the following figures has shown this relationship of poverty to the size of the family in Paris (Nombre D'Enfants par Families, Journ. de la Soc. de Statistique de Paris, April, 1901, p. 134. Quoted in Bailey's "Modern Social Conditions," p. 111), in the following table showing the number of children per 100 families in Paris, classified according to the economic resources of their parents (1896):

Very poor.....	156
Poor.....	144
Comfortable.....	131
Very comfortable.....	129
Rich.....	129
Very rich.....	127
Entire city.....	140

a somewhat larger proportion of the mothers of large families were rated as unsatisfactory in these respects than of those with small families.* The mothers of the larger families also ranked lowest when graded according to their knowledge, or rather their observance, of the laws of hygiene, this being especially evident when they were graded according to their standards of cleanliness and of ventilation.†

But all this leaves unanswered the question whether, other things being equal, the number of children in the family into which the infant is born has any direct postnatal influence upon the mortality rate. Doctor Newsholme, an eminent English authority, feels that it does not. He says, though he gives no data to sustain his opinion, that "large families evidently do not necessarily imply a tendency to high infant mortality. The connection often observed between a high birth rate and a high rate of infant mortality probably is due in great part to the fact that large families are common among the poorest classes, and these classes are specially exposed to the degrading influences producing excessive infant mortality."‡ This view, however, seems very onesided. While it is undoubtedly true, as has already been shown, that "the de-

*These figures were as follows:

Of 341 mothers of whom an opinion was given 81 were unfavorable; classifying these according to the number of the mother's pregnancies (including the one resulting in the birth of the infant under consideration) they were found to include:

- 8 per cent. of those who had had 1 pregnancy,
- 29 per cent. of those who had had 2, 3, or 4 pregnancies,
- 30 per cent. of those who had had 5 or more pregnancies.

†Thus, 781 out of 1,817 mothers from whom information was obtained said that they did not ventilate their bedrooms at all at night.

These included:

- 40 per cent. of those who had had 1 pregnancy,
- 44 per cent. of those who had had 2, 3, or 4 pregnancies,
- 46 per cent. of those who had had 5, 6, 7, or 8 pregnancies, and
- 32 per cent. of those who had had 9 or more pregnancies.

Thus, with one exception the per cent. of mothers who said that they did not ventilate their bedrooms at night increased with the number of the mother's pregnancies. This exception, which occurs with the mothers who had 9 or more pregnancies, may be due to chance, as the group included only forty cases.

Dr. Herman Schwarz in the First Annual Report of the Free Out-door Maternity Clinic (New York, 1910), p. 41, gives similar figures verifying the statement that the mothers of the larger families rank lower in general intelligence and in knowledge of hygiene than those of smaller families.

Thus, out of 679 mothers, 67 were graded as unsatisfactory in intelligence and 612 as satisfactory, the average number of children born per family being 3.8 among the former and 3.1 among the latter.

Of 670 mothers 491 were graded as having an unsatisfactory and 179 as having a satisfactory knowledge of infant hygiene, the average number of living births per family being 3.9 among the former and 3.5 among the latter.

‡Great Britain, Local Government Board, Supplement to the Thirty-ninth Annual Report, p. 49.

grading influences producing excessive infant mortality" also tend to produce excessively large families—or else both the degrading conditions and the excessively large family are produced by the same deeper-lying causes—it is also just as true that an excessive number of children in the family in itself brings about conditions in the home that lower the infant's chances of survival. The term "large family" is, of course, relative. In some cases, where the parents have sufficient resources, interest, and leisure from other duties, what might otherwise be regarded as an excessively large family would under such circumstances be regarded only as normally large. On the other hand, it is difficult to understand how, in cases where the parents have not the resources, the interest, or the ability to provide for more than three children properly, the chances of survival of subsequent infants born into the family will not be lessened, other things being equal, by the birth of more than this number of children.

It is not difficult to understand how the popular misconception that the death rate in large families is low has arisen. The large families we meet so impress us with the number of children who are living that we forget the number who have died while, again, we never notice the small families that would have been large if so many of the children had not died during infancy and childhood. The writer has been unable to find any evidence whatever to support this popular belief that large families have low infant mortality rates, while there is abundance of evidence to show that the rate of infant mortality increases with the size of the family, and no small amount of evidence to show that the mortality rate for children and even adults is greater in large families than in small.*

The Influence of the Length of the Interval Between the Mother's Pregnancies.—As has already been intimated, the influence—both prenatal and postnatal—of fertility and the size of the family on infant mortality is partly determined by the length of the interval between the mother's pregnancies or deliveries.

*See especially the article by March in the *Journal of the Royal Statistical Society*, Vol. LXXV, pp. 519 ff., previously quoted, and Dr. R. J. Ewart's two articles in the *Eugenics Review* on "The Aristocracy of Infancy and the Conditions of Birth," Vol. III, pp. 142-70, and "The Influence of Parental Age on Offspring," Vol. III, pp. 201-232. In the latter of these articles Doctor Ewart shows how the mean height of children is also affected adversely by the order of birth (p. 213).

Where this interval is large the influence of large families is less but where it is small it is much greater. The relation between the average interval between the pregnancies of the mothers visited in the Boston investigation and the rate of infant mortality is shown in the following table:

TABLE V.

MORTALITY RATE PER 1,000 BIRTHS FOR INFANTS BORN TO MOTHERS VISITED IN THE HOUSE-TO-HOUSE INVESTIGATION IN BOSTON, CLASSIFIED ACCORDING TO THE AVERAGE INTERVAL BETWEEN PREGNANCIES.

Average Interval between Mother's Pregnancies.	Number of Births.	Infant Mortality Rate.
1 year or less.	159	138.4
1½ years.	197	147.2
2 years.	641	127.9
3 years.	458	128.8
4 years.	113	106.2
5 years and over.	67	185.0
Total.	1,635 (a)	132.1

(a) Information was not obtained in 57 instances. The 371 infants who were born during their mothers' first pregnancies are not included in this table.

Table V may at first sight seem to show no relationship between the average interval between the mother's pregnancies and the rate of infant mortality. Thus, although the rate decreases as the length of the interval increases until the period of five years and over is reached (from 143 where the average interval was less than two years to 128, 129 and 106 where it was two, three, and four years respectively) it then increases to 185 deaths per 1,000 births with the group of mothers the average interval between whose pregnancies was five years and over. Moreover, although the mortality rate for the first two groups combined (one year and less and one and one half years) is greater than that for the next three the rate for the first group proves to be higher than that for the second when they are separated (138 and 147 respectively). Yet, closer examination of the results shows that these apparent exceptions are not of sufficient importance to influence the conclusion.

In the former case, the rise in the mortality rate with the group where the interval between pregnancies was five years or over can be accounted for in two ways; first, on the supposition that the number of cases included in the group is too

small (67) to allow any weight to be given it in drawing conclusions, or, second, on the supposition that such an exceptionally large interval between pregnancies as five years or more is, among families of the class for the most part visited in this investigation, generally the result, not of choice but of weakness or physical incapacity—a condition which would be likely to effect the strength and resistance of such children as might be born and thereby to raise the mortality rate for the class.

In the latter case, the fact that the rate for the group of infants born to mothers with an interval between pregnancies of one year or under is less than that for those where the interval was one and one half years does not disprove the existence of a relationship between the infant mortality rate and the length of the average interval between the mother's pregnancies because the rate for the first group where the average interval was less than one year would have been much higher if it were not composed so exclusively of mothers who had had few previous pregnancies and whose families were, therefore, small—a class which, as has already been shown, tends to have a very low infant death rate. In fact 70 per cent. of the mothers in this group had had only one previous pregnancy.

To fully appreciate the influence of this small interval between pregnancies the mothers in the group must be further classified according to the number of their previous pregnancies. When this is done it will be seen that the mortality rate for the infants born to mothers in the group who had had 1, 2, or 3 previous pregnancies was 129; for those who had had 4, 5, or 6 it was 333; while for those who had had over 6 previous pregnancies it reached the enormous proportion of 500 deaths per 1,000 births. A careful examination of the table, therefore, indicates, when account is taken of the number of the previous pregnancies and the size of the families of the mothers included in each group, that there is a striking relationship between the rate of infant mortality and the average interval between the mother's pregnancies.

Doctor Ewart in a recent article in the *Eugenics Review* emphasized this need for the "adequate spacing of births" by showing that the physical development of the children who

survive is retarded by a short interval between births. Thus, as he shows in the following table, the average height and weight of over 800 children at the end of the sixth year of age was greater where the interval between births was large than where it was small:

TABLE VI.
RELATIONSHIP BETWEEN THE LENGTH OF THE INTERVAL BETWEEN BIRTHS AND THE MEAN HEIGHT AND WEIGHT AT THE END OF THE SIXTH YEAR OF AGE AMONG 866 CHILDREN OF MIDDLESBOROUGH, ENGLAND; 1911. (a)

Interval Between Births.	Mean Height in Inches.	Mean Weight in Pounds.
Less than 2 years.....	38.6	37.2
2 and under 2½ years.....	39.9	38.8
2½ to 3 years.....	40.3	39.1
3 years and over.....	41.7	39.4

(a) R. J. Ewart, M.D., "The Influence of Parental Age on Offspring," *Eugenics Review*, Vol. III, p. 211.

In commenting on this table Doctor Ewart says: "The female is used to the greatest extent that her fertility will allow; births at intervals of eleven months being quite common. . . . The birth interval is so short that the mother is unable to bring her whole vitality to bear. Thus one child, as it were, spoils the next." He then asks this very pertinent question: "Which is the most desirable, three children of a mean height of 39.5 inches or two of 41.0 inches, with all the other attributes of mankind altered in the same proportion?"

. . . As regards the individual there is no hesitancy as to the answer; but from the point of view of economic production it is quite possible that three inefficients may be better and do more work than the two efficient. Racial supremacy, however, is not a question of numbers, and concerns individual fitness only."

It must not be forgotten, moreover, that the mothers themselves do not escape without injury from the strain put upon them by too frequent childbearing; but this lowering of the vitality and strength of the mother as a result of an insufficiency of time between the two pregnancies for complete recovery from the strain of the first creates a condition which will be likely, other things being equal, to harmfully affect both the prenatal and postnatal development of subsequent

children. In fact, both the mother and the children suffer when the length of the interval between births is too small. It is manifestly impossible for most mothers to properly nourish themselves, a new born baby, and a child within the uterus at the same time.

This point is especially important, for artificial feeding is more often resorted to by these mothers who are attempting to rear two babies at once—one within the womb and the other just born. Among the mothers visited in the Boston enquiry, for instance, 25 per cent. said that they had resorted to the use of bottle feeding because the quantity or the quality of their breast milk was reduced by a subsequent pregnancy. Among the Italian mothers this reason was given in over half the cases—a truly astounding proportion. Thus, when it is remembered that bottle feeding decreases the chances of survival of the baby from three to five times (as all authorities agree),* it can readily be understood how the coming of one child spoils the chances of survival of the previous one.

It is thus apparent that the influence of fertility and the size of the family, especially when combined with the influence of the length of the interval between pregnancies, constitutes an important factor in infant mortality. As Doctor Ewart says: "The wastage of life, and production of immature progeny with its consequent misery and suffering to the mother, can, to a much larger extent than is generally believed, be traced directly to the unfortunate fact that the fertility of women between their twenty-fifth and thirty-fifth years exceeds their power to reproduce healthy offspring."† However dangerous "race suicide" and the declining birth rate may be there can be little doubt that excessively large families is no remedy, and however desirable a high rate of births may be it is mere waste to bring children into the world faster than the laws of nature decree to be desirable.

*See, for instance, the report of the investigation by the Children's Bureau of Infant Mortality; Johnstown, Pa., pp. 38-4, Davis' "Statistical Comparison of the Mortality of Breast-fed and Bottle-fed Babies" in the *Am. Journ. of Diseases of Children*, March, 1913, pp. 234-47, and the U. S. Bureau of Labor's Investigation of Infant Mortality in Fall River, Mass.

†Prev. cit., p. 215.

IV.

THE MOTHER AND INFANT MORTALITY.

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March, 1916, pp. 66-79.*

IV.

THE MOTHER AND INFANT MORTALITY.

Even the most hasty examination of almost any report on vital statistics will show how widely rates of infant mortality vary in different countries, states, cities, and other communities. This is a phenomenon of great significance to students of infant mortality because it brings us face to face with the question of causes. Why is the infant mortality rate lower in one country than in another, in one city of the same country than in another, in one ward or locality of the same city than in another? Thus, the wide variation in infant mortality in different areas and localities immediately challenges investigation into the relation of housing and living conditions, of sanitation and congestion, of rates of wages, and of social conditions in general, to the proportion of the infants born to those who die in such areas. In the same way any similar variation found to exist, when the infant death rates of a large number of families are compared, will suggest an inquiry into the relationship existing between the proportion of infant deaths in families and the age of the mother, the size of the family, the character and intelligence of the parents, and domestic conditions in general. It is with one phase of this aspect of the problem that this article will deal—the relation of the mother, her age, her character, her intelligence, and her knowledge of infant hygiene, to infant mortality and to her baby's health.

It is obvious that this variation in the proportion of infant deaths in families cannot be shown by the use of the usual infant mortality rate based on the proportion of deaths to 1,000 births because the number of both births and deaths in any family is too small for such a comparison. The only feasible method is the very indirect one of comparing the number of infant deaths that have previously occurred in families with the infant mortality rate for such families in any given year. If the families in which a large proportion of infant deaths have previously occurred contribute a larger number of deaths to the total infant mortality of the year in

question than those families in which no previous infant deaths have occurred, it will follow that in the former group of families infants tend to die in larger proportions than in the latter; or, in other words, that the proportion of infant deaths to births is year after year larger in some families than in others. This was the method followed in an investigation of infant mortality in Wards 6, 8, 13, and 17 of Boston by the Research Department of the Boston School for Social Workers.* The results of this phase of the inquiry are set forth in the following table where the mortality rate for infants born in 1910 and classified according to the number of infant deaths that occurred among the children previously born to their mothers is given—the number of previous children born into the family being taken into account by an additional classification of the mothers according to the number of their previous pregnancies:

TABLE SHOWING (A) NUMBER OF BIRTHS AND (B) DEATHS PER 1,000 BIRTHS IN 1910 IN FAMILIES VISITED IN BOSTON CLASSIFIED ACCORDING TO THE NUMBER OF DEATHS DURING INFANCY WHICH OCCURRED AMONG CHILDREN BORN IN PREVIOUS YEARS AND THE NUMBER OF THE PREVIOUS PREGNANCIES OF THE MOTHERS. (a)

Families Classified According to the Number of Deaths During Infancy Which Occurred Among Children Born Previous to 1910.	Families Classified According to the Number of the Mother's Pregnancies Occurring Previous to 1910.			
	Total.	1, 2, or 3	4, 5, or 6	Over 6
(A) NUMBER OF BIRTHS IN 1910 IN:				
All families (b)	1671	961	487	223
Families with no previous infant deaths	1192	807	297	88
Families with one or more previous infant deaths	479	154	106	135
Families with—				
One previous infant death	331	134	118	79
Two previous infant deaths	115	19	62	34
Three or more previous infant deaths	33	1	10	22
(B) DEATHS PER 1,000 BIRTHS IN 1910 IN:				
All families	134	126	126	146
Families with no previous infant deaths	117	114	125	125
Families with one or more previous infant deaths	173	188	179	148
Families with—				
One previous infant death	154	194	153	89
Two previous infant deaths	191	158	210	177
Three or more previous infant deaths	303	...	300	318

(a) This table is intended to show the relationship between the infant death rate in 1910 in the families visited and the infant death rate during previous years in the same families. Since it is not possible to compile a true infant mortality rate based on the ratio of deaths to 1,000 births for so small a unit as the family this double classification, according to the number of previous infant deaths and the number of the mother's previous pregnancies—this last being a rough approximation of the number of births—has been substituted.

(b) Information was not obtained in 21 instances. The 371 infants who were born during their mother's first pregnancy are omitted from this table.

* The writer is indebted to Dr. J. R. Brackett, director of the School for Social Workers, for the use of these figures which have not been previously published. The investigation was made in the academic years 1910-11 and 1911-12. During the second of these years the field work was carried on under the direction of the writer supervised by the director of the Research Department, Dr. T. W. Glocker.

An examination of this table shows that the rate of mortality for infants born to mothers, none of whose previous children have died during infancy, is strikingly less than the rate for those whose mothers have already had one or more infant deaths. Moreover, the rate rises as the number of previous infant deaths in the family increases and varies in the same manner when the infants are also classified according to the number of their mothers previous pregnancies.* The conclusion that infant mortality rates for families vary as widely as those for states and cities appears, therefore, to be justified. The table also shows that the rate of infant mortality in any community is determined, not by the relatively uniform occurrence of deaths in all families, but by their relatively frequent occurrence in certain especially unfortunate families, and that the high mortality rate for the period of infancy is to be laid at the door of these relatively few families where the proportion of infant deaths to children born is especially large.

This, however, is merely another way of saying that the proportion of infant deaths to births in families varies in the same way that it does in other divisions of the population. Having shown this—and it would probably have been admitted *a priori* by many—it will be necessary to study at length the nature of some of the domestic and social conditions which cause the regular occurrence of a high ratio of infant deaths to births in certain families, while others escape with a smaller proportion of deaths or none at all; and to ascertain, if possible, why in any district parents may be found who have successfully reared every member of a large family, while side by side with them are other families in which numerous infant deaths have occurred. Among these “domestic factors” of infant mortality one of the most important is the mother, her age, her health, her character and intelligence, and her devotion to the child.

The Influence of the Age of the Mother at the Birth of the Child. The relation of the age of the mother at the birth of her child to the rate of infant mortality has been frequently commented upon, though not always made the subject of careful study. It is often asserted on the one hand that young mothers, because their strength has not been depleted

* The one exception in the case of the mothers with one, two, or three previous pregnancies and two previous infant deaths is probably due to chance as there were only nineteen births and three deaths included in the group.

by previous childbearing or by the cares of a family, tend, other things being equal, to give birth to healthy children and that the rate of mortality among their infants is, therefore, very low. On the other hand, it is probably as often claimed that young mothers are too immature to give birth to healthy and well formed children and, in addition, often incapable through the lack of previous experience of giving them the needed care after birth, as a consequence of which the mortality among their infants is relatively high. The following table summarizes the data bearing on this aspect of the subject which have been collected in five recent investigations:

MORTALITY RATE PER 1,000 BIRTHS AMONG INFANTS INCLUDED IN FIVE INVESTIGATIONS, CLASSIFIED ACCORDING TO THE AGE OF THEIR MOTHERS.

Age of the Mother.	Number of Births.	Infant Mortality Rate.
BOSTON (MASS.) INVESTIGATION. (a)		
All ages.....	2,025	125
Under 21 years.....	145	90
21 to 25 years.....	559	109
26 to 30 years.....	573	131
31 to 35 years.....	440	132
36 to 40 years.....	241	149
Over 40 years.....	67	164
FALL RIVER (MASS.) INVESTIGATION. (b)		
All ages.....	746	202
Under 20 years.....	29	103
20 to 29 years.....	386	189
30 to 39 years.....	257	206
40 and over.....	36	222
Unknown.....	38	—
JOHNSTOWN (PA.) INVESTIGATION. (c)		
All ages.....	1,463	134
Under 20 years.....	95	137
20 to 24 years.....	454	121
25 to 29 years.....	391	143
30 to 39 years.....	449	136
40 years and over.....	74	149
EWART'S INVESTIGATION (ENGLAND). (d)		
Under 19 years.....	152	171
20 to 24 years.....	536	132
25 to 29 years.....	396	166
30 to 34 years.....	316	170
35 to 39 years.....	150	220
Over 40 years.....	36	330
BIRMINGHAM (ENG.) INVESTIGATION. (e)		
All ages.....	3,773	176
Under 25 years.....	936	207
25 to 35 years.....	1,982	167
35 years and over.....	855	163

(a) No information was obtained in 38 instances. For source of data see first note.

(b) Dublin: Infant Mortality in Fall River, Mass.—A Survey of the Mortality among 833 Infants Born in June, July, and August, 1913. *Quarterly Publications of the American Statistical Association*, New series, No. 110, June, 1915, p. 515.

(c) U. S. Children's Bureau: Infant Mortality: Johnstown, Pa., Washington, 1915, p. 35.

(d) R. J. Ewart, M. D.: The Aristocracy of Infancy and the Conditions of Its Birth. *The Eugenica Review*, Vol. III, p. 166. The writer does not state where his data were collected but from a later article in the same journal it is to be inferred that they were collected in Middlesborough, England.

(e) Health Department of the City of Birmingham, England: Report on Industrial Employment of Married Women and Infant Mortality, 1911 (p. 11) and 1912 (p. 11).

Interpretation of the data presented in this table is somewhat difficult because of the complex factors involved and because the results of the five investigations differ considerably. In the first two, Boston and Fall River, the rate of mortality was lowest for the infants born to the very young mothers under 20 and 21 years of age. In both also the rate increased regularly with the age of the mother after the twentieth year, the highest rate occurring among the infants whose mothers were over 40. In two others, Johnstown and Ewart's, the rate was higher for the children of the very young mothers under 19 or 20 than for those whose mothers were between the ages of 20-30 and 30-35 years. These two investigations agree with the first two, however, in showing that the rate is highest of all among the infants whose mothers were 40 years of age or over. Finally, when the figures for Birmingham are examined, exactly the opposite tendencies are revealed, the rate for the older mothers being lower than that for the younger.

There seems to be a general agreement in the results of the first four of these investigations in showing that the chances of survival are greater for infants born to mothers between the ages of 20-25, and 35-40 than for those born to mothers over 40. The results for Birmingham do not share in this agreement but in interpreting these figures the fact must be considered that no separate data were given for the very young mothers under 20 or the very old mothers over 40 years of age. The results of the five investigations are not in sufficient accord to justify any conclusion as to the rate of mortality among the infants of very young mothers. This question must, therefore, be left in doubt—at least as far as the available statistics are concerned.

On the other hand, in drawing conclusions from these figures the mere fact that the results of the five investigations differ is in itself significant. It indicates, in the writer's opinion, that the age of the mother is not a factor in infant mortality of primary importance. The figures do not show that mothers can obtain the knowledge necessary for bearing and rearing babies only from experience acquired with age. In fact, except for the very young mothers, these figures seem to show that, as far as infants are concerned, one may fairly

expect as high a degree of efficiency in motherhood from the young and inexperienced mothers as from the older—a conclusion which from the standpoint of prevention it is not necessary to point out.

The Influence of the Character and Intelligence of the Mother. But if the age of the mother is not a factor in infant mortality of primary importance, her health, her character, and her intelligence certainly are. It is difficult for the careful student of this problem to avoid the conclusion that the real underlying factor of infant mortality and the chief consideration in the health and welfare of babies is the strength, character, health, and intelligence of the mother. For instance, it is the mother's health and strength that determines whether it is physically possible for the baby to start life with the tremendous advantage that comes from breast feeding and it is her character and intelligence that largely determine how the child shall be fed when either method is possible. Again, in the recent campaign that has arisen for the control of the influence of prenatal conditions on infant mortality it is evident that the mother is the all-important consideration. Certainly, while the child is developing in the mother's womb her health and strength, the care she takes of herself, and her general standards of hygiene are among the most important considerations in determining whether or not the baby after its birth will get a fair start in life or die in a few weeks or months from prenatal causes.*

But even after the physical connection between mother and child is severed at birth the infant is little less dependent upon its mother, for she determines to a very large extent the character of everything with which it comes into contact—food, sunlight, cleanliness, and even the kind of air it breathes. In both the Boston and Johnstown investigations a close relationship between bad housing conditions and infant mortality was found to exist, but it should not be forgotten in interpreting these figures that the closeness of this relationship is also to a large extent determined by the mother.† From even the briefest investigation it will be evident that even in the

* See the writer's article on "The Influence of Prenatal Conditions on Infant Mortality," *Proceedings of the Southern Sociological Congress*, 1915.

† See the writer's article on "Infant Mortality and Urban Housing, and Living Conditions," *Journal of Sociologic Medicine* (American Academy of Medicine), October, 1915.

poorest districts, where the housing and living conditions are exceedingly bad, many instances in which parents have reared large families without the occurrence of a single death are to be found, while side by side with these in the same neighborhood or even in the same house are to be found other families in which numerous deaths of infants have occurred. Such instances as these, where other differences between the families concerned appear to be so small, seem logically to be the result not of poverty, or the cleanly or sanitary condition of the home, or even of the physical strength of the parents, but of the amount of intelligent attention and care which the mother bestows upon her baby. In such cases it is not only the "resistance of the child" but the "resistance of the mother" that determines the extent of the influence of the other factors on the problem.

The influence of the character and intelligence of the mother on the rate of infant mortality is exceedingly difficult to measure statistically. It is especially difficult to distinguish this influence from that of the other closely related factors and one can never feel certain that the desideratum, "other things being equal," has been reasonably well attained. It is not to be expected, therefore, that the relationship between the character and intelligence of the mother and the rate of infant mortality can in the nature of the case be so accurately measured as to show the extent of the influence of the former on the latter, although the application of the statistical method does show the existence of such a relationship.

Thus, in the Boston investigation it was found that of the 341 mothers, upon whose general intelligence and standards of child care the investigators felt competent to express an opinion, the rate of mortality (99.6) was lower for the 254 infants of whose mothers a favorable opinion was given than the rate (103.4) for the 87 infants whose mothers were criticised unfavorably. These figures are of somewhat doubtful value, however, as they are based on an opinion formed upon only one visit and include only the somewhat extreme cases upon each end of the scale, all the other mothers in between being omitted, as the investigators did not feel competent to express an opinion upon them. A similar attempt

was made by Dr. Schwarz to grade the mothers coming under the observation of the New York Free Out-Door Maternity Clinic according to their general intelligence, which was more successful, as it was based on a much larger number of cases. Thus, among 2,326 infants whose mothers were rated as unsatisfactory in general intelligence the rate of mortality was 126 deaths per 1,000 births in comparison with a rate of 100 for the 210 infants whose mothers were rated as satisfactory in this respect.* These figures are also of doubtful value as the standard of intelligence used must have been high to have excluded such a large proportion of the mothers from the satisfactory grade.

A number of attempts have also been made to show the relationship of the intelligence of the parents to infant mortality in which literacy is used as a test of intelligence. Thus, Dr. Schwarz, in the study referred to above, shows that the rate of mortality among 1,297 infants, both of whose parents were literate, was 111 deaths per 1,000 births, while among 702 others, only one of whose parents was literate, the rate was 113, and among 458, where both were illiterate, it was 172.† In a similar manner it was shown in the Johnstown investigation that the rate of mortality was higher among infants born to foreign-born mothers who could not read and write any language or who could not speak English than among those infants whose mothers could meet these tests. Thus, of the 229 mothers who could not read and write, the infant mortality rate was 214, while among the 419 mothers who could read and write it was only 148. Among the 401 infants, whose mothers could not speak English, the mortality rate was 187 in comparison with a rate of 146 among those whose mothers could speak English.‡ In so far, therefore, as literacy and ability to speak English are indices of intelligence these figures indicate, though probably not adequately, the heavy handicap under which babies are placed because of a lack of intelligence on the part of their mothers.

* First Annual Report of the Free Out-Door Maternity Clinic, Covering the First Nine Years of the Clinic's Experience. New York, 1910; Chapter 2, Part 2, Report of the Pediatric Department, with a Study of Early Infant Mortality, by Herman Schwarz, M. D., p. 41.

† Loc. cit., p. 39.

‡ U. S. Children's Bureau: Infant Mortality: Johnstown, Pa. Washington, 1915, p. 34

Other writers have shown the existence of this relationship between literacy and infant mortality by correlating the percentage of illiteracy and the rate of infant mortality in a number of cities. For instance, Phelps, in his recent study of the relation of infant mortality to the employment of mothers, concludes, after a careful examination of the available statistics for the cities and states of New England and especially of the cities of Massachusetts, that a high female illiteracy is "with fair uniformity coexistent with a high infant mortality rate." * Newman also notes the relationship from a study of English figures, although he does not find it to be as close as the writer just cited.†

On the whole, however, the extent of the influence of the character and intelligence of the mother upon infant mortality is not capable of statistical demonstration or of exact measurement by any method so far devised. Nevertheless observation and experience show that it is an all-important factor in the problem—the underlying factor which determines to a great extent the influence of other measurable factors. In conclusion, therefore, it may be said of this article, as Dr. Newman says of his own excellent work on the subject:

This book will have been written in vain if it does not lay the emphasis of this problem upon the vital importance to the nation of its motherhood. Wherever we turn, and to whatever issue, in this question of infant mortality, we are faced with one all pervading need—the need of a higher standard of . . . motherhood. Infant mortality in the early weeks of life is evidently due in large measure to the physical condition of the mother, leading to prematurity and debility of the infant; and in the later months of the first year infant mortality appears to be due to unsatisfactory feeding of the infant. But from either point of view it becomes clear that the problem of infant mortality is not one of sanitation alone, or housing, or indeed of poverty as such, but *is mainly a question of motherhood*. No doubt external conditions as those named are influencing maternity, but they are, in the main, affecting the mother, and not the child. Improved sanitation, better housing, cheap and good food, domestic education, a

* Edward B. Phelps: *Infant Mortality and Its Relation to Woman's Employment—A Study of Massachusetts Statistics*. In Volume XIII, Part I, of the Bureau of Labor's Report on Condition of Woman and Child Wage Earners in the United States, p. 48.

† George Newman, M. D.: *Infant Mortality*. London, 1906, p. 222.

healthy life of body and mind . . . exert but an indirect effect on the child itself, who depends for its life in the first twelve months, not upon the state or the municipality, nor yet upon this or that system of *creche* or milk-feeding, but upon the health, the intelligence, the devotion and maternal instinct of the mother. And if we would solve this great problem of infant mortality, it would appear that we must first obtain a higher standard of . . . motherhood. Without a moment's hesitation I place this need as the first requirement. Other things . . . are important, but this is the chief thing.*

To this conclusion the present writer heartily subscribes. The most important factors in infant mortality are the strength, the health, the character, and intelligence of the mother.

Preventive Methods: Education for Parenthood. Space would not permit, even if such a thing were possible, an enumeration of all the agencies and influences in modern life which are helping to raise the standard of motherhood or of all those other agencies and influences which are helping to lower it. It will be desirable, however, to conclude this discussion of the relation of the mother to infant mortality with at least a brief survey of some of the chief methods whereby the standard of motherhood, and also of fatherhood, may be raised. Probably the most important of these methods is education—the instruction and training of mothers and potential mothers in the care and rearing of children.

In a recent pamphlet, issued by the Children's Bureau on Baby-saving Campaigns, the methods employed by certain American cities in the prevention of infant mortality were pointed out—the work of health departments, registration of births and deaths, provision of a pure milk supply, milk stations and baby clinics, encouragement of maternal feeding, "little mother leagues" and classes, visiting nurses, prenatal work with expectant mothers, improvement of housing and living conditions, fight against flies, garbage accumulation, and dust, fresh air camps and hospitals, educational work through the distribution of circulars, pamphlets, etc.† A

* Ibid, pp. 257-258.

† U. S. Children's Bureau: Baby Saving Campaigns. Washington, 1911. See table of contents.

careful examination of each of these methods of preventing infant mortality will at once reveal to what a large extent each depends for its effectiveness upon the mother. At first sight it would appear that the chief function of a milk station is to provide cheap and pure milk and yet, as the report just referred to points out, "it has been the experience of practically all milk dispensaries that it is useless to send pure, clean milk into a dirty home to be handled by an ignorant, dirty mother or older child. It is necessary to reach the mothers, and not only teach them how to care for the baby's milk, but to convince them of the necessity of cleanliness. . . . In many cities it is believed that the principal good to be derived from milk stations consists in the opportunity given for those in charge to come in contact with the mothers and with the home surroundings. . . . Many cities place practically all the emphasis upon visiting nurses and the instruction of the mothers in the homes." * Dr. Josephine Baker, director of child hygiene of the Department of Health of the City of New York, also expressed the same idea in an address before the International Congress of Hygiene and Demography at Washington in 1912: "Without overlooking the value of pure milk, I believe this problem must primarily be solved by educational measures. In other words, the solution of the problem of infant mortality is 20 per cent. pure milk and 80 per cent. training of the mothers. The infants' milk stations will serve their wider usefulness when they become educational centers for prenatal instruction and the encouragement of breast feeding and teaching of better hygiene." †

In the case of visiting nursing, it is, of course, not necessary to point out that it is the function of such nurses not to care for the child themselves but to instruct the mother in the proper care of children.

Recently the work of visiting nurses has been extended to include the instruction of expectant mothers during the period of pregnancy. This "prenatal care," as it is often called, is

* *Prev. cit.*, pp. 22-23, and 32.

† *Transactions*, Vol. 3, p. 149.

one of the newest and one of the most important direct means of reducing infant mortality by the education of the mothers, for the instruction is begun not after the child is born but soon after it has been conceived.

Finally, among the methods of instructing mothers in the proper care of children after the birth of the child or after conception, should be mentioned the educational work that is being carried on through the distribution of circulars, pamphlets, etc., on the care of infants and children as well as upon general hygiene and health. The volume of such publications, as well as the character of the material and the method of presentation and distribution, is improving rapidly. State and city boards of health and many private societies and associations have issued many exceedingly valuable pamphlets written in such a way as to appeal effectively to the mothers interested. Some of these have been printed in foreign languages as well as in English. The Federal Public Health Service and the Children's Bureau have also issued similar publications. The latter bureau is issuing a *Care of Children Series*, two numbers of which have already appeared. The first, "*Prenatal Care*," deals with the care of mothers during pregnancy, while the second, "*Infant Care*," gives the mother specific instruction as to the care of the baby after birth. Both of these pamphlets are written in popular, non-medical terms and are admirably suited to their purposes.

The trouble with the publications of the Children's Bureau, as well as those of the Public Health Service, is that the amount of funds available has heretofore been so small that they have not been as widely distributed as they should be. If these bulletins on the care of children, for instance, were as widely distributed as the Department of Agriculture's very successful series of *Farmers' Bulletins*, we should feel more confident that the government is doing its part in the prevention of infant mortality than is possible at present. On the other hand, the work of many city health departments has not been so limited by a lack of funds. In a number of cities educational pamphlets and folders are sent to each mother upon the registration of the birth of the child, either through the

mails or by the hands of a visiting or health nurse. Effective use has also been made of newspapers for the instruction of mothers in a number of cases.*

But this instruction of mothers in the care of themselves during pregnancy and of their babies after their birth is not the only means of reducing infant mortality by means of education. This kind of instruction may be called *instruction or education of parents*; but there is another kind of education that begins at childhood and which may be called *education for parenthood*. To say that "our educational system needs revision and that it should be made to conform more nearly to the actual requirements of our complex daily life" is merely to repeat a statement that has been made many times already; and yet there can be little doubt that one of the most effective means of lowering the rate of infant and child mortality, as well as the general death rate for all ages, would be the education of children and young men and women for parenthood. Just how much of this education should be given in the home and how much in the schools, and just how much should be obtained by the study of the laws of health and hygiene or by the study of domestic science and home management, it is impossible to say at present. What can be said at present is that the need of education for parenthood cannot be denied and that, in the overhauling and revision of our system of education which is going on at present, efficient methods for meeting this need must be worked out.†

But education for parenthood should include more than instruction in the science and art of infant and child care, or in home management or even in the ideals of parenthood; it should also include instruction, direct or indirect, in "the selection of parents." To take the case of the girl, for instance, education for parenthood,

* U. S. Children's Bureau: Baby-saving Campaigns, pp. 44-45 and Appendix.

† One of the most interesting of the recent attempts to instruct and educate children directly in the care of babies and in the laws and rules of infant hygiene has been carried on by the Department of Health of the City of New York in its lectures and classes for the "little mothers" who attend the city schools. Little Mothers' Leagues have also been organized which have reached a membership of over 17,000. These leagues were described by Dr. Baker in her address before the International Congress of Hygiene and Demography previously referred to. The idea has also been put in operation in other cities. Another movement of the same kind that should at least be mentioned is the establishment of continuation schools for homemaking.

instead of concerning itself with the care of her baby, will be at work when she is choosing the baby's father. In all times and places, woman's primal and supreme function is or should be that of choosing the father of the future. This great idea should be recognized, implicitly and explicitly, in the education of every girl; she is or may be partly responsible for the future of mankind. She herself, mind and body, is holy, for she is the temple of the life of this world to come. She must honor and care for herself accordingly; and this twofold aspect of her present and future duty, in caring for herself and in choosing her co-creator of the future, must be instilled into her mind with the solemnity, the sanctity, and the authoritative sanction of a religious dogma. *

This quotation, in suggesting how the standard of parenthood may be raised by eugenics, both on its positive side of the encouragement of the marriage of the fit and on its negative side of the discouragement or prevention of the marriage of the unfit, the unhealthy, and the weak, opens up an interesting field for discussion but one which, even if space would permit, it would hardly be proper for us to enter upon here.

* Saleeby, C. W.: *The Methods of Race Regeneration*. New York, 1911, p. 36.

V.

INFANT MORTALITY AND URBAN, HOUSING, AND
LIVING CONDITIONS

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V.

INFANT MORTALITY AND URBAN, HOUSING, AND LIVING CONDITIONS.

Even the most hasty examination of almost any report on vital statistics will show how widely infant mortality rates vary among different countries, states, cities, and other communities. A recent report of the Registrar-general for England shows that the mortality rates for infants varied from 204 deaths per 1,000 births in Hungary for the five-year period from 1906 to 1910 to about 70 in New Zealand and from 313 in Moscow to 85 in Sydney and 92 in Stockholm. In a similar way the annual reports of the Bureau of the Census on mortality statistics of the registration area of the United States show how year after year certain states and cities have higher infant death rates than others. In these cities also the rates are not equal everywhere, some of the wards and blocks having rates much higher than the average for the city as a whole while others have rates much lower. Such wide and constant variations are not due to chance and the many attempts that are now being made to discover their causes and to explain why certain types of communities, cities, states, and countries have a high infant mortality rate while others, often not far distant, have a moderate or even a very low rate furnish one of the most interesting and helpful fields of discussion in vital statistics. All the causes of infant mortality are concerned in this question but in accounting for strictly community variations, community and home conditions are especially important. It is with some of these conditions that this article will deal.

THE INFLUENCE OF URBAN CONDITIONS OF LIFE ON INFANT MORTALITY.

One of the most striking and constant differences in mortality rates existing in the whole field of vital statistics is to be found when urban and rural districts are compared. The difference appears whenever the deaths of persons of all ages in the two areas are compared; but it is especially great in the case of in-

fants and young children, those classes of the population most affected by the influence of adverse environmental conditions. Thus, Bulletin 109 of the Bureau of the Census shows that in 1910 the death rate per 100,000 population for infants was 36 per cent. higher in the cities (326) than in the rural parts of the registration area (240). The per cent. of excess of the death rate for children under five years of age in the cities (460) was 38 per cent. higher than in the country (333) while the per cent. of excess of the rate for persons of all ages was only 19 per cent. higher in the cities (1,590) than in the country (1,340). Confining ourselves strictly to the problem of infant mortality it will be necessary to examine certain aspects of this excessive urban mortality in detail, with a view particularly to ascertaining to what extent the excess of deaths in the cities is due to preventable conditions. The following table shows the death rate in 1911 per 1,000 population under one year of age for infants classified by age at death in the cities and rural parts of the registration states with the per cent. of excess of the rate for the cities over that for the rural districts.¹

Age at death.	Cities.	Rural districts.	Per cent. of excess.
Under 1 year.....	135.9	94.1	44
Under 1 week.....	34.7	28.7	21
1 week to 1 month.....	18.8	14.9	26
1 to 3 months.....	24.6	15.9	55
3 to 5 months.....	24.6	15.5	59
6 to 8 months.....	18.6	10.8	72
9 to 12 months.....	14.4	8.4	71

An examination of this table shows that the infant death rate per 1,000 population under one year of age is higher in the cities than in the rural parts of the registration states at each age period but that the per cent. of excess of the rate for the cities increases with the age at death, being least during the first week and month and greatest during the last six months of infancy. Thus, the infant death rate for the cities in the age period from six to twelve months exceeded that for the country districts by about 70

¹ Twelfth Annual Report of the Bureau of the Census on Mortality Statistics for the year 1911, pp. 537-8. Population in 1911 estimated by the Bureau of the Census.

per cent., while for the period from three to five months the per cent. of excess was 59, for the period from one to three months 55, and for the periods from one week to one month and under one week only 26 and 21 per cent., respectively. The greatest excess of the urban over the rural death rate thus occurs during the later and not the earlier months of infancy. Before pointing out, however, that the excessiv death rate is due to preventable conditions, the causes of the deaths of infants in the two areas should be compared. This is done in the following table which shows the infant death rate in 1911 per 1,000 population under 1 year of age from certain important causes for the cities and the rural districts of the registration states, with the per cent. of excess in the rate for the cities over that for the rural districts:¹

Cause of death.	Cities.	Rural districts.	Per cent. of excess.
All causes.....	135.9	94.1	44
Diarrhea and enteritis.....	371.2	191.6	71
Premature birth.....	210.8	157.7	34
Congenital debility.....	168.5	119.2	41
Injuries at birth.....	45.1	26.4	71
Congenital malformations.....	66.6	57.6	16
Broncho pneumonia.....	111.5	52.4	113
Pneumonia.....	59.3	51.0	16
Acute bronchitis.....	37.0	21.5	72
Convulsions.....	30.8	26.4	17
Meningitis.....	18.3	16.7	10
Tuberculosis—all forms.....	25.1	16.6	5
Measles, diphtheria and croup, whooping cough, and scarlet fever.....	50.0	45.8	9
Syphilis.....	22.1	4.6	38
All other causes.....	142.8	154.0	8 ²

From every cause of death of sufficient importance to warrant its separate inclusion in the table the death rate per 1,000 population under one year of age was greater in the cities than in the rural

¹ Prev. cit., pp. 537-38.

² Per cent. of excess of rate for rural districts over that for cities.

districts. The difference in the rates from each cause varied considerably. The per cent. of excess of the death rate for the cities over that for the rural districts from broncho pneumonia, diarrhea and enteritis, acute bronchitis, and injuries at birth was greater than that for all causes combined. The per cent. of excess from congenital debility, premature birth, congenital malformations, pneumonia, convulsions, meningitis, the five infectious diseases, measles, diphtheria, croup, whooping cough, and scarlet fever, syphilis, and all forms of tuberculosis was less than that for all causes combined. Grouping these causes of death in accordance with the international classification it will be seen that in general the higher infant death rate in the cities than in the rural parts of the registration states is the result of a higher death rate from all important causes. The diseases of the digestive and respiratory systems (pneumonia excepted) play a larger part, however, in making up the excessive urban death rate than do the diseases of early infancy (injuries at birth excepted), congenital malformations and the diseases of the nervous system.¹ This fact that the diseases of the digestive and respiratory systems have the predominant influence in causing the higher infant death rate in urban than rural districts has frequently led to the statement that the excessive rate for cities is due to "bad air" and "bad feeding" or "impure milk" diseases. Such a statement does not represent the entire truth, however, for, as this table shows, the infant death rate from all important causes is higher in the cities than in the country. Rather should it be said that "bad air" and "impure milk" diseases play the most important part in bringing about the higher rate of mortality in urban than rural districts.

It has now been shown that, altho the death rate is greater in urban than in rural districts in each age period of infancy, the

¹ Of the two exceptions to this generalization, injuries at birth and pneumonia, the former may be due to differences in certifying and diagnosing causes of deaths in urban and rural districts—altho this is by no means certain. In any case, the per cent. of infant deaths in the registration states from injuries at birth was so small (3 per cent.) in comparison with the much greater proportion caused by the other diseases of early infancy (16 per cent. from premature birth and 12 from congenital debility) that the tendency shown by the above classification is not vitiated thereby. The exception in the case of pneumonia is more important, however, as the deaths from this cause constituted a rather large proportion of the deaths from respiratory diseases and it should prevent the pushing of the conclusion drawn from the classification too far.

per cent. of excess of the rate for the cities over that for the country districts increases in direct ratio with the age of the child, being least during the first weeks and months of infancy and greatest during the last. In a similar manner it has also been shown that, altho the infant death rate from every important cause of death is greater in urban districts, the per cent. of excess of the rate for the cities over that for the country districts is much greater in the case of the diseases of the digestive and, to a lesser extent, of the respiratory system than in the case of the diseases of early infancy and congenital malformations. Both of these facts—that the infant death rate in cities is especially high during the last six months of infancy and that it is especially high from digestive and respiratory diseases—indicate that the higher mortality rate among infants in cities than in rural districts is largely due to the influence of “postnatal” conditions affecting the infant after birth. Now, as the writer has shown in another article,¹ the deaths of infants resulting from the influence of postnatal conditions are more easily prevented than those due to the influence of prenatal conditions. The conclusion, therefore, seems well founded that the higher rate of infant mortality in urban than rural districts is to a large extent the result of preventable causes.

Further than this it is very difficult to go in the search for the causes of the higher mortality rate among infants in urban than in rural districts for it is well nigh impossible to put one’s finger on the specific factors which bring about the difference. Congestion and overcrowding, impure air and bad sanitation certainly play a large part; but they are not the only, or perhaps, even the most important factors concerned. When urban and rural mortality is compared there are many things to consider. In cities there is probably a wider and more extensive interest in the prevention of infant deaths than in the country. Medical attendance, hospitals, free dispensaries, and other artificial means of curing disease and prolonging life are better developed as a rule in cities than in the country, while in some cities the water supply and

¹ Southern Sociological Congress: Proceedings of the annual meeting for 1915—Health Crusaders. Nashville, 1915. Space does not permit the writer to quote from this article more in detail.

sanitation are also better than in small villages and country places. On the other hand, other conditions are present in large towns and cities which counteract these advantages. The milk supply is usually not so good as in the country while the natural aids to survival and the prevention of sickness are less effective. The effect of bad sanitation, poverty, impure air, a poor water supply and the neglect of the elementary requirements of health is also probably greater in the cities. Excessively large families also probably exert a greater influence on infant mortality in cities than in the less-crowded country communities while a smaller number of children would constitute a "large family" in the cities than in the country.¹ The employment of women in extra-domestic occupations is also more extensive in the cities and large towns and artificial feeding is probably more often employed there also. Finally, domestic and home conditions in general are probably on the whole more favorable to infant life in the country than in cities. As Dr. Newman says, "the homelessness of the people is one of the worst features of town life, and is operating injuriously on infancy. Of that I do not think there can be any doubt in the mind of a careful observer of the life of the poor in a great city. He may not be able to put his finger upon any one item which is affecting the mother and killing the infant, for an infant is a complex organism, and bears within itself a temperament, a physique, and a heredity composed of a vast array and medley of influences inextricably interwoven. But he will be able to say that the general conditions of domestic life in a city tenement are such as to make the rearing of infants a difficult and doubtful undertaking."²

THE RELATIVE DECLINE IN INFANT MORTALITY IN URBAN AND RURAL DISTRICTS.

On the other hand, conditions in cities have greatly improved in the last generation as a result of the great advances in sanitation and preventive medicine and of the widespread efforts that

¹ See the writer's article in a recent number of the *Quarterly Publication of the American Statistical Association on Infant Mortality and the Size of the Family*. (September, 1915.)

² George Newman, M.D., *Infant Mortality—A Social Problem*. London, 1906, p. 180.

have been made to prevent disease and lengthen life; and on the whole this improvement has probably been greater in the cities than in the country districts. This would lead one to expect that the markt decline¹ which has occurred in the infant mortality rate in recent years will be found upon comparison to have been greater in the cities than in the country. Unfortunately such a comparison cannot be made for most countries or for any part of this country because figures extending over a sufficiently long period to avoid the influence of superficial and temporary conditions are lacking. The only countries for which such figures are available are Germany and Prussia and these are given in the following table which shows the decline in the infant mortality rate per 1,000 births for the cities and the country districts of Prussia between 1876-80 and 1901-03 and of Germany between 1886-90 and 1907-08:

Years.	Cities.	Country districts.
PRUSSIA. ²		
1876-80.....	211	183
1881-85.....	211	186
1886-90.....	210	187
1891-95.....	203	187
1896-1900.....	195	185
1901-03.....	180	176
GERMANY. ³		
1886-90.....	210	187
1896-1900.....	195	185
1901-06.....	181	178
1907-08.....	156	164

An examination of this table shows that in both countries the decline in infant mortality in the period considered was greater in the cities than in the country districts. In Prussia the per cent. of decrease in the rate for the cities was 14.7 per cent., over three

¹ See the Twelfth Annual Report on Mortality Statistics for the year 1911 (pp. 24-26) by the U. S. Bureau of the Census.

² Zeitschrift des Koeniglich Preussischen Statistischen Landesamts, Bd. XV, s. xvii. Infants of illegitimate birth not included in either case.

³ Statistik des Deutschen Reichs. Quoted in Dr. Helen MacMurchy's Spec. Rep. on Infant Mortality to the Leg. Assembly of Ontario, Toronto, 1911, p. 26. She does not cite the source of this data. Years 1891-96 were not included.

times as great as in the country (3.8), while in the German Empire the decline in the cities (25.7 per cent.) was almost twice as great as that in the country (12.3 per cent.). Moreover, in Prussia the falling off in infant mortality was so much greater in the cities than in the country that by the end of the period 1901-03 the rates had become practically equal, while in Germany the decline in the cities was so much greater that at the end of the period 1907-08 the rate for the cities had reached a point somewhat lower than that for the country—a very unusual condition to say the least.

The lack of statistics prevents the continuance of this comparison for other European countries so that no general conclusion as to the relative decline of infant mortality in urban and rural districts can be drawn for the continent as a whole.¹ An indirect method of comparison is possible, however, from which a very strong probability can be established that tendencies in other European countries in this respect are not different from those in Prussia and the German Empire, *i. e.*, that of comparing the decline in the infant mortality rate for the large cities of each country with that for the country as a whole. Applying this method of comparison to the countries and cities included in the section on vital statistics of the annual reports of the Registrar-general for England and Wales,² the following table showing the percentages of decrease in the infant mortality rate during the period from 1881-85 to 1906-10 for the countries and their large cities has been drawn up.

¹ Somewhat similar figures can be compiled from the Sixty-fifth to the Seventy-third Annual Reports of the Registrar-general for Births, Deaths, and Marriages in England and Wales showing the decrease in the infant mortality rate for rural and urban counties between 1897 and 1910. These figures are of no value in this connection, however, since it is not urban and rural districts that are being considered but a group of "counties which are mainly urban in character" with another group "in which the rural character greatly predominates, altho the group contains some considerably urban communities." Since 1910 this method has been given up in favor of another which furnishes "a more satisfactory basis of comparison," *i. e.*, "one in which the representative urban area is entirely urban and the representative rural area entirely rural." See also annual report for 1906, Vol. 69, pp. xxvii and lxxi.

² Seventy-third and Seventy-fourth Annual Reports of the Registrar-general for Births, Deaths, and Marriages in England and Wales, pp. xciv and 105-15, respectively. Rates for 1881-85 and 1906-10 are five-year averages.

AUSTRALIAN COMMONWEALTH	37.6	THE NETHERLANDS	31.5
Sydney	50.9	Amsterdam	55.7
Melbourne	44.4	Rotterdam	49.8
DENMARK	20.0	The Hague	53.7
Copenhagen	36.1	NORWAY	29.3
ENGLAND AND WALES	15.8	Christiania	39.7
London	24.0	PRUSSIA	18.8
FRANCE	24.6	Breslau	32.9
Paris	34.6	Berlin	41.3
HUNGARY ¹	18.4	Hamburg ²	32.4
Budapest ¹	24.1	Dresden ²	35.4
IRELAND	0.0	Munich ²	42.6
Dublin	17.0	SCOTLAND	4.3
Belfast	4.7	Glasgow	13.2
ITALY	17.3	Edinburgh	6.3
Milan	17.3	SWEDEN	32.8
		Stockholm	55.6

Thus, in every country of Europe and Australia for which statistics are available with one unimportant exception a greater decrease occurred in the rate of infant mortality for the large cities than for the country considered as a whole. The single exception was in the case of Italy where the decline in the rate for the country as a whole and for the one large city included was the same.

Similar data are available for only one state in this country, Massachusetts, where the decline in the rate for the state as a whole can be compared with that for Boston, the chief city. Thus, between 1881-85 and 1906-10 the infant mortality rate for Boston declined from 186 to 133, a decrease of 28.5 per cent., while the rate for Massachusetts declined from 160 to 133, a decrease of only 16.9 per cent. Starting at the beginning of the period with a rate of 26 deaths for 1,000 births higher than that for Massachusetts the decline in Boston was so much greater that by the end of the period both rates were equal.³

¹ Per cent. of decrease between 1891-95 and 1906-10.

² These three German cities, tho not in Prussia, are added for comparison.

³ Figures for Massachusetts are from the 17th Annual Report of Births, Deaths, and Marriages for the year 1911, p. 180, and for Boston from the 40th Annual Report of the Department of Health for the year 1911, p. 171. This same method of comparing the decline in the infant death rate for the states included in the registration area in 1900 which occurred between the census year 1900 and the calendar year 1911 with the decline in the

Obviously these figures cannot be accepted as an entirely adequate substitute for a direct comparison of the decline of infant mortality in urban and rural districts such as was given for the European statistics and Massachusetts. They do show clearly enuf that in all countries for which statistics are available the infant mortality rate has declined more during this period of thirty years in the large cities than in the country districts and small towns. The exclusion of the cities from the returns for the entire country, which would be necessary in compiling the rate for the rural districts, would make the contrast between the large cities and the rest of the country all the more striking. It is not certain, on the other hand, altho it is highly probable, that the decline in the rate for the large cities is a fair index in this respect of tendencies existing in all cities or urban districts as a whole. Yet, taken in conjunction with the figures for Prussia and Germany comparing the decline in the two areas directly, they do create a very strong probability, if not the certainty, that the decline

cities of 100,000 inhabitants or over in each state can be made from the table given in the Eleventh Annual Report of the Bureau of the Census on Mortality Statistics for 1911 (p. 25). The per cent. of decrease in the infant death rate per 1000 population under one year of age for these states and cities during this period was as follows:

MICHIGAN.....	8	CONNECTICUT.....	17
Detroit.....	16	New Haven.....	13
Grand Rapids.....	27	Bridgeport.....	20
NEW JERSEY.....	21	MASSACHUSETTS.....	19
Jersey City.....	27	Boston.....	17
Newark.....	33	Worcester.....	17
Paterson.....	38	Fall River.....	21
NEW YORK.....	19	Lowell.....	27
Buffalo.....	7	Cambridge.....	33
Albany.....	18	RHODE ISLAND.....	30
New York.....	31	Providence.....	36
Syracuse.....	+11		

An examination of these figures shows that in three of the six states a smaller per cent. of decrease occurred in the infant death rate for the state at large than for any of the cities, while in the three others the per cent. of decrease in the rate for the state was greater than that of about half the cities in each case. These figures are of practically no value for the purpose because they extend over too short a period of time to avoid the risk of the over-influence of temporary and superficial factors and because they are based on one year periods instead of five year periods, as was the case in the tables giving the figures for the European countries and for Massachusetts. These two objections make the use of these figures as an indirect means for comparing the decline in infant mortality in urban and rural districts of little value.

in infant mortality which has occurred during the last thirty years has been greater in urban than in rural districts.

It has now been shown that the rate of infant mortality is generally higher in urban than rural districts and that the excessive death rate for the cities results, to a much larger extent, from the influence of postnatal than prenatal conditions and to a larger extent from preventable than nonpreventable causes. In view of this it has also been stated that the recent decline which has occurred in infant mortality should be expected to result in a greater proportional reduction in the rate for urban than rural districts. The lack of statistics extending over a sufficiently long period has made it impossible to show this directly except for two countries but the use of an indirect method of comparing the per cent. of decrease in the rate for an entire country with that for its chief cities showed that the decline in infant mortality during the last thirty years in the principal foreign countries was greater in the large cities than the rural districts. This also proved to be the case in the one state of this country where such a comparison could be made, Massachusetts. In the two countries where a direct comparison was possible, Prussia and Germany, it was shown that the per cent. of decrease in the infant mortality rate for the urban was greater than that for the rural districts. From this direct and indirect method of comparison the conclusion is to be drawn that in countries where the rate of infant mortality has been declining for a considerable period this decline has probably been greater in urban than rural districts.

The significance of the greater decline in the number of infant deaths in the cities than in the country is obvious. It is decidedly encouraging when considered from the standpoint of the prolongation of life and the conservation of the public health; for this marked decline in the mortality of infants in cities has been brought about by methods which if applied in a similar manner in the country and in small towns would probably yield as gratifying results. Such figures as these just quoted demonstrate beyond a doubt that the improvement in sanitation, in housing, and in living conditions in general, combined with the great advances in preventive medicine, has been so successful in the cities

that a wider extension of the campaign to the country is imperative.¹

THE INFLUENCE OF CONGESTION AND OVERCROWDING ON INFANT MORTALITY.

One of the conditions producing a higher rate of mortality in urban than rural districts is, as has already been pointed out, congestion and overcrowding. The influence of this factor is very difficult to measure and this must be fully appreciated at the outset. It is a factor, moreover, the influence of which can never be entirely separated from that of the other closely related conditions, such as poverty, the size of the family, and the character, strength, and intelligence of the mother. These two difficulties combined with others that might be mentioned make the study of the influence of congestion and overcrowding on infant mortality a very difficult one and necessitate the use of the most refined methods if conclusions are to be drawn with any assurance of accuracy.

Broadly speaking, there are two methods of approach to the problem; first, by the study of congestion and overcrowding as measured by the density of population per acre or square mile in a given area; and, second, as measured by the number of persons per room in individual households. It is obvious that the first of these methods of studying congestion in relation to area is very crude and defectiv. Certainly when the areas compared are whole countries or even cities, no conclusiv results can be expected, as such areas are not even approximately equally congested in all their parts or sufficiently alike in other respects to justify the making of such a comparison. Neither can the wards of a city when compared be expected to show any significant relationship between density of population per acre and the rate of infant mortality. Such comparisons have often been made but always with unsatisfactory results. In Boston, for instance, practically no relationship whatever can be found to exist be-

¹ For a good example of preventiv work which reaches rural as well as urban districts see the recent report of the U. S. Children's Bureau on the New Zealand Society for the Health of Women and Children—an Example of Methods of Baby-Saving Work in Small Towns and Rural Districts. This publication can be obtained from the bureau free of charge.

tween density of population per acre on occupied land in the various wards and the rate of infant mortality.¹ Wards 6 and 8 where density of population is greatest usually have very low, and sometimes the lowest, rates of infant mortality in the city, while in the other wards the relationship between the two conditions is no closer.

The reason for this is not that no relation exists between congestion and infant mortality but that density of population per acre is too crude a method of measuring degrees of congestion and overcrowding to bring out the true relation to mortality. Ward lines were not intended to mark off sanitary or overcrowded areas and they are very rarely even approximately uniformly congested in all their parts, different sections, blocks, and tenements presenting an infinit variety of degrees of congestion. The population, moreover, is usually far from homogeneous in nationality, economic condition, and standards of life—to mention only a few of the diversities. It is very doubtful whether it is possible to divide a city into such homogeneous and evenly congested districts that, when classified according to density of population per acre, any conclusiv relationship to the rate of infant mortality will be revealed. As has already been pointed out congestion is so inextricably interwoven with the other factors of the problem that a much better method of measuring it than density of population per acre is necessary. To study the problem with any hope of accurate results it will be necessary to carry the investigation into individual households and to study the relation of congestion to infant mortality family by family.

It should also be mentioned, before leaving this fase of the subject, that it is very doubtful whether density of population per acre has any markt influence on infant mortality in itself. As Dr. Newsholme, the eminent English public health officer, has pointed out, "given houses properly constructed and drained, and given cleanly habits on the part of the tenants, increast aggregation of population on a given area has no influence in raising the death rate, except in so far as it is accompanied by

¹ See the Report of the Massachusetts Homestead Commission, Boston, 1913 (House Document No. 2000), p. 20.

overcrowding in individual rooms, an evil which is by no means necessary under the circumstances named. In other words, there is no causal relationship between density of population *per se* and a high mortality. The true index of density is the number of persons to each occupied room."

Realizing the inadequacy of density of population per acre as an index of congestion, Dr. George Newman, Medical Officer of Health of the Metropolitan Borough of Finsbury, Central London, in studying the problem of infant mortality in his own district, used a method which closely approximated, altho it does not fully meet the requirements of "the true index" as prescribed above by Newsholme. In this investigation, the results of which are summarized in the following table, he correlated the rate of infant mortality with the number of rooms which the family occupied:¹

Size of tenement.	Number of births.	Infant mortality rate.
The borough.....	2,886	148
One room.....	532	219
Two rooms.....	1,216	157.
Three rooms.....	468	141
Four rooms and over.....	464	99
Unknown.....	206	39

An examination of this table shows that in this district of Central London the number of rooms which the family occupies is an important factor in infant mortality. This method of studying the problem, however, does not take account of the number of persons in the family. Yet, in spite of this limitation, the table can be taken as furnishing a fairly accurate general indication of the influence of congestion and overcrowding on the death rate among infants, since it would appear that even the smallest family would find a one-room tenement very congested quarters and that the family of average size would find themselves very much overcrowded in a two-, and moderately overcrowded, in a three-room tenement.

In tabulating the results obtained in an investigation of infant mortality in Wards 6, 8, 13, and 17 of Boston, recently made by

¹ Geo. Newman, M.D.: *Infant Mortality*. London, 1905; p. 184.

the Research Department of the Boston School for Social Workers, the use of the average number of persons per room in the home as an index of congestion and overcrowding was first considered; but several objections to this method soon appeared.¹ In the first place, lodgers and boarders often cause a higher degree of congestion in the family than their actual numbers indicate, as the rooms which they occupy are not always as crowded as those which are left for the children and the father and mother. Some families also set aside one room for use as a parlor or for some other similar purpose, even tho it be at the expense of greatly overcrowding the other rooms, while others do not—and no account of this difference is taken when the number of persons and the number of rooms is combined in a ratio. But the chief objection to the use of the average number of persons per room as an index of congestion in the homes of the infants visited is a practical one arising from the fact that the visit was not made until the child was a year old which often made it impossible for the mother to recall just how many persons were living with the family, including lodgers, boarders, relatives, grown children, and others, during the first year of the child's life. In other cases the number of persons in the family is not the same thruout the entire year, while in still others the family may have moved to a new home where the number of rooms was not the same as in the old. All these objections and others that might be mentioned tend to lessen the value of the average number of persons per room as a measure of the extent of congestion and overcrowding in the infant's home during its first year of life.

There is another method of measuring the extent of congestion and overcrowding in the home, however, which is not subject, to such a large extent, to the objections just named and which, altho it has not been often used, was found in both the Boston and Johnstown investigations to provide the best working method for attaining this end—the number of persons sleeping in the room

¹ The writer is indebted to Dr. J. R. Brackett, Director of the School for Social Workers, for the use of data collected in this investigation which will be quoted later on. These figures have not been previously publisht. The investigation was made in the academic years 1910-11 and 1911-12. During the second of these years the field work was carried on under the direction of the writer supervised by the director of the research department, Dr. T. W. Glocker.

with the infant. The advantages of this method over the others are plain. It considers the use to which the rooms are put—if the actual congestion in the bedrooms and the rest of the house is increased by the withholding of one room for use as a parlor or if lodgers occupy a larger proportion of the rooms in proportion to their number than the other members of the family this condition will, in the great majority of cases, be reflected in the number of persons sleeping in the room with the infant. The number of persons sleeping in the room with the infant is also more easily and more accurately obtainable in a great many cases than the number of persons in the home, particularly when the family “takes in lodgers” and when relatives and grown children live with the family at certain times but not regularly. When the infant’s sleeping room only is considered account can also be taken of the size of the room, a thing which is practically impossible when all the rooms in the home are taken into account. As has been frequently pointed out, the influence of congestion and overcrowding is so closely interwoven with that of the other domestic and social factors of infant mortality that in the study of the problem the method of measurement chosen is of fundamental importance.

The following table shows the relationship between congestion and overcrowding, as indicated by the number of other persons sleeping in the room with the infant, and the rate of mortality for infants visited in both the Boston¹ and Johnstown investigations:

BOSTON INVESTIGATION.²

Number other persons sleeping in room with infant.	Number of births.	Infant mortality rate.
Total.....	1,899	92.2
Two or less.....	1,315	86.7
Three	403	81.9
Four or more.....	181	154.7

¹ See previous note. Visits were made in this investigation to the homes of all the infants born in the four wards in 1910 with a few exceptions. Answers were obtained in 2,063 cases.

² Information was not obtained in 164 instances.

JOHNSTOWN INVESTIGATION.¹

Number other persons sleeping in room with infant.	Number of births.	Infant mortality rate.
Total.....	1,382	87.8
Two or less.....	600	66.7
Three, four, or five.....	725	97.9
Six or more.....	57	122.8

Thus, in both the Boston and Johnstown investigations the infant mortality rate was found to vary in direct ratio with the number of other persons sleeping in the room with the infant—or, in other words, with the degree of congestion and overcrowding in the household. Thus, in Boston the rate was over three times as high in the homes where four or more other persons slept in the room with the infant as in those where only two other persons or less slept in the room, while in Johnstown the infant mortality rate was almost twice as high where six or more persons slept in the room with the infant as where two other persons or less slept in the room.

It is worth while to study separately the influence of congestion and overcrowding among the Italian families visited in Boston, since extreme overcrowding was so much more common among them than in any other nationality. Over twice as large a proportion of the infants of Italian parentage who were included in the investigation slept in a room with four or more other persons than was the case among infants of any other nationality (18.2 per cent. in comparison with 7.2 per cent. among the Irish, the next in order). The effect of this high degree of congestion and overcrowding on the rate of infant mortality is reflected in the following figures:

Of the 709 infants of Italian parentage² included in this investigation, 414 slept in a room with two other persons or less, 166 with three other persons, and 129 with four or more. Among the infants in the first group who slept in a room with two other persons or less the rate of mortality was 86.9, among those who slept in a room with three other persons it was higher, 102.4, while among those who slept in a room with four other persons or more the rate was highest of all, 155 deaths per 1,000 births.

¹ U. S. Children's Bureau: *Infant Mortality: Johnstown, Pa.* Washington, 1915, p. 25. No information obtained in 7 instances. No infants who did not live at least one month are included.

² Reference is to infants both of whose parents were born in Italy. The term "nationality" was also used above in the same sense.

Turning now to a more detailed study of the effect of congestion and overcrowding in Boston, it is significant that where the overcrowding was so great that it was necessary for four or more other persons to sleep in the same room with the infant the rate of mortality showed a decided variation with the size of the room, being lowest when the room was large and enormously higher where it was small. This will be seen upon examination of the following table which, altho it is based on a rather small number of cases, is probably in approximate accord with actual conditions. It shows the mortality rate per 1,000 births for infants visited in the Boston investigation who slept in bedrooms with four or more other persons, the rooms being classified according to their relative sizes.¹

Size of bedroom.	Number of births.	Infant mortality rate.
Total.....	162	142
Large.....	48	42
Medium.....	84	155
Small.....	30	267

The evil effects of congestion and overcrowding are greatly increased by the presence of boarders, lodgers, and other persons in the home who are not members of the family circle. This is due both to the fact that such persons, by each occupying a larger proportion of the household than any member of the family frequently increase congestion to an extent out of proportion to their actual numbers, and that their presence in the home, especially in the poorer sections where the number of rooms in the average tenement is small, prevents privacy and necessitates the substitution of an abnormal form of community life for that of the normal family group. This latter condition is moral and social, using the term in a broad sense, as well as sanitary, and it probably exerts a greater direct influence upon the parents and the older children in the family than upon the baby. Yet this effect, thru its influence upon the mother, her standards of child care, and the amount as well as the character of the attention she can give to her children, reacts no less powerfully, tho indirectly, on the infant. In view of the fact that

¹ No information as to size of bedroom was obtained in 19 cases.

"probably one-fourth of the foreign-born families in the United States" "take in" boarders and lodgers—not to speak of the nativ-born families—the influence of this factor both directly and indirectly must be considerable.¹ How important its influence really is, however, the difficulty of applying the statistical method to this fase of the problem has so far made it impossible to determine.

THE INFLUENCE OF HOUSING AND LIVING CONDITIONS ON INFANT MORTALITY.

The study of housing and living conditions in relation to infant mortality may for convenience be divided into three parts: first, the character and location of the house or apartment and the equipment of the home; second, the care of the home by the occupants; and, third, the number of persons living in the home in proportion to its size and the degree of relationship of such persons to the head of the family. The last of these three aspects of the problem has just been discust in the preceding section on the influence of congestion and overcrowding and the practice of taking in boarders and lodgers on infant mortality. Consideration must now be given to the other two.

In the last section attention was drawn at the outset to the necessity of exercising great care in the selection of a method of measuring degrees of congestion and overcrowding and of applying it in actual practice. The difficulties, however, of measuring the extent of overcrowding and congestion are not nearly so great as those incident to any attempt to grade homes according to the kind of care which the family takes of them. For this reason it is almost impossible to devise a working method for accurately measuring the extent of the influence of the hygienic and sanitary condition of the home on infant mortality. In both the Boston

¹ In the recent investigation by the immigration commission it was found that 27.2 per cent. of the foreign-born families investigated kept boarders or lodgers. This practice was especially common among the Lithuanians (70.3 per cent.), the Poles (35.5), the Slovaks (41.0), the Russian Hebrews (32.1), and the South Italians (22.4). Of the nativ-born white families 13.0 per cent. kept boarders or lodgers and of the nativ-born Negro, 33.7 per cent. See Reports of the Immigration Commission, *Immigrants in Cities—A Study of the Population of Selected Districts in New York, Chicago, Philadelphia, Boston, Cleveland, Buffalo, and Milwaukee*. Washington, 1911, Senate Document No. 338, Vol. 1, p. 81.

and Johnstown investigations attempts were made to measure the influence of this factor by using cleanliness and ventilation as indices of home sanitation and domestic hygiene. The method used in grading the homes visited in the Boston inquiry, however, was so rough that the data collected could not be used in determining the effect of bad sanitation on infant mortality, altho this information does furnish a valuable rough indication of the extent to which bad sanitary conditions were present in the homes visited.

In Johnstown, on the other hand, sufficiently refined methods of measuring degrees of cleanliness and of adequacy of ventilation in the homes visited were employed to enable the results to be used in determining the relationship between infant mortality and domestic hygiene and home sanitation. The following table summarizes the results of this investigation:¹

Grading of home.	Number of births.	Infant mortality rate.
CLEANLINESS.		
Total.....	1,463	134.0
Clean.....	943	113.5
Moderately clean.....	354	163.8
Dirty.....	166	186.7
VENTILATION. ²		
Total.....	1,386	87.8
Good.....	604	28.1
Fair.....	392	91.8
Poor.....	390	169.2

An examination of this table shows a close relationship between the rate of infant mortality and the cleanliness and ventilation of the home. Thus, the rate for the infants who lived in dirty homes was over a third higher than that for the infants whose homes were clean. The difference between the well and poorly ventilated homes was even greater; only 28 deaths per 1,000 births occurred in the well ventilated homes while 169

¹ U. S. Children's Bureau: *Infant Mortality*. Johnstown, Pa. Washington, 1915, pp. 23 and 26.

² Only infants who lived at least one month included here. No information was obtained in 3 instances.

occurred in those which were poorly ventilated. The influence of bad home sanitation on the rate of infant mortality appears, therefore, to be markt.

As has already been shown, these figures are also of value as furnishing an indication of the kind of care which the mothers visited take of their homes. They may also be compared with the similar data gathered in the Boston and other investigations. In reference to ventilation an examination of the table shows that only 604, or somewhat less than half of these Johnstown homes visited were well ventilated, altho an additional 392, or 28 per cent., were fairly well ventilated. In Boston, on the other hand, the proportion of inadequately ventilated homes was probably even greater, since 785, or 43 per cent. of the 1,825 mothers from whom information was obtained admitted that they never kept a window open at all at night except in warm weather.¹

When graded according to cleanliness homes everywhere, as far as can be determined from the available statistics, show a much more favorable condition than in respect to ventilation. Thus, in Johnstown only 11 per cent. of the homes were graded as dirty (24 per cent. being graded as moderately clean, and 65 per cent. as clean) while 44 per cent. were found to be poorly ventilated. In Boston also only 15 per cent. of the homes included in the inquiry were found to be dirty at the time of the agent's visit² while, as has just been shown, 43 per cent. of the homes, on the statement of the mothers themselves, were never ventilated at night in winter.

Similar data collected by the United States Immigration Commission in its investigation of the population of selected districts in seven large cities, altho the question of ventilation was not considered, show about the same proportion of badly cared for and dirty homes (16 per cent.). The grading of the 10,123 households or apartments visited in this investigation was not based exclusively on cleanliness but on "the degree of care which char-

¹ From the other 1,040 mothers who said that they did keep a window open at night accurate enuf information could not be obtained to determine whether or not the actual amount of ventilation secured was adequate to meet the needs of the family and the baby.

² The method of grading the homes visited in the Boston investigation was much rougher than the one used in Johnstown and, therefore, less exact.

acterized them at the time of the agent's visit," altho "in determining the degree of care both cleanliness and tidiness were taken into consideration." The detailed results were as follows: of the 10,123 homes visited 45 per cent. appeared to be well cared for and 39 per cent. fairly well cared for, while 13 per cent. appeared to be badly and 3 per cent. very badly cared for. In other words, 84 per cent. were well or fairly well cared for and 16 per cent. badly or very badly cared for.¹

Besides the care of the home by the occupants and its sanitary and hygienic condition, the equipment of the house or apartment and housing conditions proper may also directly affect the health of the infant and its chances of survival. Indirectly they exert an influence upon the problem of infant mortality by increasing the difficulty of the mother's caring properly for the home or for her children. This fase of the problem was inquired into in some detail in the Johnstown investigation, the results of which are summarized in the following table showing the relation of "housing accommodations" to infant mortality:²

Housing accommodations.	Number of births.	Infant mortality rate.
Total.....	1,461 ³	134.0
Water supply in house.....	1,173	117.6
Water supply outside house.....	288	197.9
City water available.....	1,333	132.0
City water not available.....	128	148.4
Water closet.....	739	108.3
Yard privy.....	722	159.3
Dry homes.....	808 ²	122.5
Moderately dry homes.....	336	139.9
Damp homes.....	319	156.7
Bath in home.....	496	72.6
No bath in home.....	965	164.8
Yard clean.....	801	99.9
Yard not clean.....	632	169.3
No yard.....	28	...

¹ Reports of the U. S. Immigration Commission: Immigrants in Cities, Vol. I, pt. 5, p. 102.

² U. S. Children's Bureau: Infant Mortality: Johnstown, Pa. Washington, 1915, p. 23.

³ Information as to dryness of home secured in 2 additional instances—total, therefore, equals 1,463.

An examination of this table shows a close relationship between housing accommodations and infant mortality. Thus, the mortality rate was considerably higher for infants living in damp homes, in homes where there was no supply of city water, and in homes where there was no water closet than for those who lived in dry homes equipt with city water connection, water closet, a bath, etc.¹

The character of housing and living conditions is determined partly by municipal regulations, partly by the standards of landlords, partly by the standards of the community in which the family lives, and partly by the wishes of the tenants themselves. Which of these exercises the greater influence it is difficult to say. Municipal regulations and the standards of landlords probably have their chief influence upon housing conditions in the strict sense but even here the choice and wishes of the tenant are very important factors, as the well-known fact that the tenants who pay the highest rents do not always receive the best accommodations would indicate.² The primary responsibility of the tenants for the interior of the apartment or dwelling, the extent to which it is overcrowded, its sanitary condition, and the adequacy of its ventilation will not be seriously disputed even tho it be realized that they are themselves in turn influenced by other conditions outside the home. It is here that the problem becomes inextricably bound up with the resources, the character and the intelligence of the parents. Living conditions in general, but especially domestic hygiene and sanitation, and the fitness of the

¹ It may well be questioned whether the character of the housing accommodations is not also an index of the economic condition of the family; in which case the effect of bad housing accommodations on the mortality rate shown above may be due partly to the influence of poverty. On the other hand too much must not be made of this as the disturbing influence of poverty may be offset by some other disturbing factor acting in the opposite direction. See the writer's article in the November issue of the *Quarterly Journal of Economics* on "The Influence of Economic and Industrial Conditions on Infant Mortality."

² Commenting on this aspect of the problem in Boston the report of the immigration commission shows how "inertia and racial cohesion may keep the tenants in their present location in spite of the fact that they can secure better accommodations for less money in other parts of the city" and remarks that it "is reasonable to suppose that the owners of the houses, rather than lose profitable tenants, would make necessary improvements if the demands on the part of the tenants were persistent enuf." See the Reports of the U. S. Immigration Commission: Immigrants in Cities. Washington, 1911, Vol. I, p. 466.

home as a place for a baby to grow up in are to a very large extent the result of that factor, the importance of which can hardly be too strongly emphasized—the strength, the character, and the intelligence of the mother. The chief effect of urban conditions of life, bad housing and sanitation, and poor living conditions upon infant mortality is in all probability not direct but indirect, in that they lower the efficiency of the mother as a mother. These external conditions no doubt exercise an important direct effect on the child but their chief influence upon the problem of infant mortality is indirect; that is, housing and living conditions exert their primary influence on the child thru the influence which they have on the health, strength, and character of the mother.

VI.

THE INFLUENCE OF ECONOMIC AND INDUSTRIAL
CONDITIONS ON INFANT MORTALITY

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VI

THE INFLUENCE OF ECONOMIC AND INDUSTRIAL CONDITIONS ON INFANT MORTALITY

I. INTRODUCTORY. OLDER AND MODERN VIEWS

THE relation between the rate of infant mortality and the proportion of women employed in gainful occupations was for the first time given serious consideration in the middle and early part of the last century, when the changes and readjustments following the industrial revolution had largely worked themselves out and the methods of the modern science of public health were brought to bear on conditions in the factory and industrial towns of England. The subject was discussed officially about 1860 in the reports of the investigations of Sir John Simon and his associates into the Sanitary State of the People of England, when it was shown, to quote the words of the report itself, "that in proportion as adult women were taking part in factory labour or in agriculture the mortality of their infants rapidly increased; that in various registration districts which had such employment in them the district death rate of infants under one year of age had been from two and a quarter to nearly three times as high as in our own standard districts; and that in some of the districts

NOTE. Reprinted from the November, 1915, issue of the *Quarterly Journal of Economics*, published by the Harvard University Press.

more than a few of the infants were dying of ill-treatment.”¹ Since the time of Simon and his associates much has been written upon the subject of women’s work and its relation to infant and child mortality. Until recently the fact that in cities and communities where a large proportion of women are employed in gainful occupations the rate of infant mortality is generally excessively high has usually been pointed to and accepted as conclusive evidence of the influence of the employment of mothers on infant mortality.

Recent writers, on the other hand, have shown that this relationship is not necessarily one of cause and effect and that the method of studying the influence of the employment of mothers on infant mortality by correlating the proportion of women engaged in gainful occupations with the infant mortality rate is faulty and inconclusive. Phelps, particularly, in his recent study of *Infant Mortality and Its Relation to Women’s Employment in Massachusetts*, has clearly shown that other adverse conditions present in the industrial cities of that state can just as well be held accountable for the high rate of infant mortality as the employment of women in industry. In commenting on the data supporting his conclusions, which space does not permit us to quote here, he says:

It has often been customary, in approaching the subject of the employment of married women in its relation to infant mortality, to ignore the many other complex social and economic factors having a bearing upon the problem. The preceding tables show clearly that . . . certain of these factors which have in the past been ignored in the consideration of the problem are with fair uniformity coexistent with a high infant mortality rate; these being (1) a high proportion of foreign-born, (2) a high female illiteracy, and (3) a high birth rate. These factors operate with equal force over large or small areas . . . accompanying the infant death rate with almost perfect

¹ Quoted in George Newman, *Infant Mortality, A Social Problem*. London, 1906, p. 92.

regularity. The [other] factor, . . . the proportion of women engaged in extra-domestic occupations . . . is found, statistically speaking, associated very uncertainly, to say the least, with the infant mortality rate. . . . It will be seen that this result clearly disproves the contention that the extra-domestic employment of women is the dominant factor in determining the infant death rate, so far as these Massachusetts cities are concerned.¹

Bearing in mind all the other factors of infant mortality which a high birth rate, a high proportion of foreign-born, and a high rate of illiteracy imply — large families, poverty, low standards of life, ignorance, bad housing and sanitation, and so on, — but to which the statistical method cannot so easily be applied for large areas, little room for doubt remains that there are many other adverse conditions in industrial cities which can with much less probability of error be held accountable for their excessive infant mortality rate than the employment of women in gainful occupations.

The *direct* influence of the employment of mothers in gainful occupations in any community on infant mortality is largely determined, not by the proportion of females ten years of age and over employed in such work, or even by the proportion of married women, but by the proportion of mothers who are at work during the infancy of their child or were at work during pregnancy. Little accurate information is available on this point, yet enough to show that the proportion of such mothers employed in gainful occupations does not account for the excessive mortality among infants in industrial cities.

II. THE STATISTICAL EVIDENCE

In a house-to-house investigation recently made by the Research Department of the Boston School for Social Workers, of infant mortality in Wards 6, 8, 13,

¹ Infant Mortality and Its Relation to Women's Employment, in vol. xiii, of the Bureau of Labor's Report on Condition of Women and Child Wage-Earners in the United States. Washington, 1912, pp. 48-49.

and 17 of Boston ¹ it was found that of 1,810 mothers from whom information on this point was secured, 101, or 5.6 per cent, were employed in some gainful occupation other than keeping boarders or lodgers either during pregnancy or for some time during the infancy of the child or during both periods. In a similar investigation by the federal Children's Bureau in Johnstown, Pa., out of 1,463 mothers visited only 3.1 per cent "went outside their homes to earn money." ² Other figures are given in the Bureau of Labor's Report on Condition of Women and Child Wage-Earners in the United States. In the volume on the Cotton Textile Industry it is shown that of the married women employed in the cotton mills of New England and the Southern states only 19 per cent had children under three years of age. ³ In a similar manner other volumes show that the per cent of such mothers employed in the men's ready-made clothing industry (home finishers not included) was only 9.9, ⁴ in the glass industry, 14.1, ⁵ and the silk industry, 17.3 per cent. ⁶ The number of mothers with infants under one year of age is not given, but it must, of course, have been very much smaller — not more than a third of the number who had children under three at most.

These figures are also indirectly corroborated by the returns of the Massachusetts census of 1905. In this census it was found that of the 573,673 mothers in the state who had children of any age, only 63,400, or 11.1 per cent, were engaged in gainful occupations. The

¹ The writer is indebted to Dr. Jeffrey R. Brackett, Director, for the use of these and other figures quoted later from the results of this investigation which have not been previously published. The visits were made to the homes of infants born in 1910 by fellows in the research department during the academic years 1910-11 and 1911-12. During the second of these years this field work was done under the direction of the writer, supervised by the director of the research department, Dr. T. W. Glocker.

² U. S. Children's Bureau, *Infant Mortality: Johnstown, Pa.* Washington, 1915, p. 47.

³ Vol. i. Washington, 1910, pp. 1016-1022.

⁵ Vol. iii.

⁴ Vol. ii.

⁶ Vol. iv.

children of these mothers were not classified according to age or the number in each family, so that it is impossible to estimate from these figures the approximate proportion of mothers at work who had children under one year of age. Obviously, however, the proportion must have been small indeed.

Some additional data bearing on the proportion of women employed in gainful occupations during pregnancy is available from the Bureau of Labor's investigation of infant mortality in Fall River, Mass. Of the 580 children dying under one year whose families were interviewed, the mothers of 45.9 per cent were at work outside the home during pregnancy. Not quite half of these continued to work until less than three months of confinement.¹ The proportion of mothers employed during pregnancy thus was about equal to the birth rate among working mothers.

It appears from the available data that the proportion of mothers employed in gainful occupations in the cities and industrial communities of the United States who have children under one year of age ranges from 3 or 4 to 8 or 9 per cent. Probably it rises rarely much above 14 or 15 per cent, even in cities like Fall River where a large proportion of the female population is engaged in gainful occupations. The proportion of married women employed during pregnancy is greater than that of mothers employed during the first year after confinement, being probably about equal to the birth rate among married women who are habitually employed. Thus the available data, altho meager, seem to be sufficient to show that in this country the proportion of mothers employed in gainful occupations, while large enough to constitute in itself an important social problem is by no means large enough to account for the excessive infant mortality of industrial communities.

¹ U. S. Bureau of Labor Report, vol. xiii, pp. 72 and 111.

The conclusion can be drawn that in industrial cities and communities the employment of mothers is not the chief or dominant direct factor in the mortality of infants, that its direct influence has in the past often been exaggerated, and, finally, that it is simply one of the adverse conditions in such communities that produce the high rate of infant mortality. How important an adverse influence it is remains yet to be determined.

As has just been shown, only 3.1 per cent of the mothers visited in the investigation by the Children's Bureau into Infant Mortality in Johnstown, Pa., were found to have been engaged in gainful occupations outside the home. In the report of this investigation, however, all mothers who gained money by keeping boarders or lodgers were classed with the mothers who went out to work as "employed mothers." Thus, the data collected in this investigation apply, not to gainfully employed mothers in the strict sense, but to mothers earning money by keeping boarders or lodgers. The results of the inquiry are summarized in the following table showing the mortality rate for infants visited in the investigation, classified both according to the employment of the mother and the annual earnings of the father.¹

Infant mortality:				Mother Gainfully Employed	Mother Not Gainfully Employed
Total	.....	.....	.....	188.0	117.6
Annual earnings of father, under \$521	.....	.....	.....	247.6	263.2
" " " \$521 to \$624	.....	.....	.....	150.9	160.7
" " " 625 to 779	.....	.....	.....	127.1	102.3
" " " 780 or over, or ample ²	.....	.....	.....	166.7	93.1

¹ U. S. Children's Bureau, *Infant Mortality: Johnstown, Pa.* Washington, 1915, p. 49.

² The word "ample" was used to designate cases "where information concerning the father's earnings was not available and the family showed no evidences of actual poverty."

Examination of this table shows that the mortality rate among the infants born to the gainfully employed mothers was much higher (188) than the rate for those infants whose mothers had no money earning occupations (118). At first sight this would seem to indicate that the work which the gainfully employed mothers were engaged in had a decidedly adverse influence on the health and mortality of their babies. This conclusion cannot be drawn, however, because closer examination of the table at once shows that the fundamental difference between the two classes of families represented is not in respect to the employment of the mother but in respect to the amount of the annual earnings of the husband. By comparing the two groups as a class without subdividing them according to the amount of the annual earnings of the father, such effect as the employment of the mother may have on the problem is masked by the influence of poverty. To overcome this difficulty it will be necessary to consider only groups at least fairly homogeneous in respect to the father's income. Examining, therefore, the lower columns of the table it will be seen then in the first two groups, which contain almost 60 per cent of the gainfully employed mothers, the infant mortality rate was higher in the families where the mother was not gainfully employed than in those where she was. Only in the upper groups, where the father's income was \$625 or over, and where the proportion of mothers who were gainfully employed was very small, was the rate higher among the employed mothers than among those not employed. This table, therefore, fails to prove that the employment of mothers in money earning occupations has a direct adverse influence on infant mortality. On the contrary, it would rather seem to indicate that in the poorer families where the earnings of the father are small the employment of mothers

in such gainful occupations as these may have a beneficial influence on infant mortality — by mitigating the evil effects of poverty.

The fact should be kept in mind, however, that the money-earning occupation of the Johnstown mothers was mainly that of keeping boarders and lodgers. It will be necessary to turn to the results of two other investigations to study the influence of the employment of mothers in factories and other places outside the home — one recently made in Birmingham, England, and the other in Fall River, Mass.

The Birmingham investigation was confined to St. Stephen's and St. George's wards of Birmingham, the two wards which contain the largest proportion of mothers engaged in gainful occupations.¹ Of the 3,777 mothers visited in the three years of the investigation, 1908-10, 1,657 were employed in gainful occupations, 1,441 being employed in factories and 675 elsewhere. The infant mortality rate was 173 among the children whose mothers were gainfully employed and 179 among those whose mothers were not so employed. In only one of the three years, 1909, was the rate higher for the children of the employed mothers (179) than for those whose mothers were not so employed (169). In no case was the difference in the rates great enough to indicate any direct relationship between infant mortality and the employment of mothers.

The most comprehensive American inquiry is that recently made by the federal Bureau of Labor into Infant Mortality and Its Relation to the Employment of Mothers in Fall River, Mass.² It differed in method

¹ Health Department of Birmingham (England), Report on Infant Mortality in St. Stephen's and St. George's Wards, 1911 (p. 7) and 1910 (p. 10). These families need not be classified according to the amount of the father's earnings, as they were sufficiently alike in this respect to be compared as a class.

² U. S. Bureau of Labor, Report on Condition of Women and Child Wage-Earners in the United States. Vol. xiii, part 2.

from the other three considered in that only infants who died during the year under consideration, 1908, and whose parents could be found by the agents of the bureau, were included. No births being included, therefore, the use of infant mortality rates based on the proportion of deaths to births was impossible.

The report of the investigation is divided into parts; the first, on Mother's Work Before Childbirth in Relation to Stillbirths and Infant Mortality, and the second, on Mother's Work After Childbirth in Relation to Infant Mortality. The following quotation from the report summarizes the conclusions of the first part.

Summarizing the results of the study of the effect upon the children of the mother's employment before childbirth, the conclusion must be reached that in Fall River . . . no marked differences are discoverable between the children of mothers at home and mothers at work outside the home.¹ A slightly larger per cent of stillbirths was reported for the mothers at home, but the per cent of the stillbirths which could be traced to the mother's work was the same for mothers at home and mothers at work. The percentage of total deaths due to diseases of early infancy (indicating prematurity, immaturity, or defects) was higher for the children of mothers at home than for the children of mothers at work. . . . The mothers at work showed a slightly higher percentage of children not well and strong at birth. *It would appear then that the conditions which were found existing do not indicate that the work of the mother in the cotton mill before childbirth was producing results noticeably different from the work [housework] of mothers at home.* It must be borne in mind, however, that the two classes, mothers at work and mothers at home, are not sharply defined and that the group, mothers at home, includes a considerable number of women who were formerly engaged in millwork and whose physical condition may still be affected in some degree by such earlier employment.²

The following statement summarizes that part of the investigation dealing with the effect of the employment of the mother after confinement on infant mortality.

¹ Of the 314 mothers at home only 6 were engaged in a gainful occupation. See p. 101. The group of "mothers at home" can, therefore, be considered as one of mothers not employed in gainful occupations.

² Loc. cit., pp. 119-120. Italics added.

Only 83, or 14.4 per cent of all the children dying under one year concerning whom information was secured, were found to have been deprived of the mother's care because of her going to work. This per cent represents the extent of the possible effect of the mother's absence from home. But the extent to which the nursing of the child was affected is smaller than even this figure indicates, for in only 41 cases, or 7.9 per cent of all those whose feeding was reported, was the mother's nursing in any way affected by her absence from home, and in the 42 other cases she either failed to nurse because of disinclination or inability, or had discontinued nursing for reasons not in any way connected with her return to work.

But while the number and per cent of children affected by the mother's absence from home was small, yet the causes of death among this number as compared with the causes among children whose mothers remained at home, show strikingly the fatal effect of the mother's absence and the lack of her care and nursing. Thus, the proportion of deaths from diarrhoea, enteritis, and gastritis among the children whose mothers went to work (62.7 per cent) was over 80 per cent in excess of that of the children whose mothers remained at home (34.6 per cent). The real significance of this excess will not be fully realized until we recall . . . that for Fall River as a whole the death rate under one year from diarrhoea, enteritis, and gastritis, was two or three times what it was in many other localities.

The much higher mortality among the children of the mothers who went to work after childbirth is plainly due chiefly to the great extent of the absence of breast feeding and of the improper feeding and the additional evil influence of the withdrawal of the mother's care. Among the mothers at home only 34 per cent of the children were nursed exclusively; while 24 per cent were given solid food, and for 16 per cent condensed milk was the principal food. Among the children of the mothers who went to work only 1.2 per cent were nursed exclusively, while 40 per cent were given solid food, and for 30.5 per cent condensed milk was the principal food.

The causes of the excessive infant mortality in Fall River may be summed up in a sentence as the mother's ignorance of proper feeding, of proper care, and of the simplest requirements of hygiene. To this all other causes must be regarded as secondary.¹

The results of these investigations, then, clearly demonstrate that the employment of mothers in gainful occupations is not the chief or even one of the more important direct factors in infant mortality. They also

¹ *Loc. cit.*, pp. 168-169.

indicate that even in industrial cities like Fall River the proportion of mothers employed in gainful occupations at any particular time is by no means large enough to exercise directly the influence on infant mortality that has frequently been ascribed to it in the past.

On the other hand, these studies do not demonstrate that because the gainful employment of mothers is not the chief direct factor in the problem that it is a factor of little importance. How important a factor it is the studies, so far as we have followed them, do not indicate. Moreover, they are so limited in nature and scope that they can throw light only on the *direct* influence of the gainful employment of the mother during pregnancy, or after confinement during the infancy of the child, on infant mortality. They cannot adequately take into account the influence of the mother's employment during childhood and young motherhood; neither can they allow for the compensating influence of the mother's employment in housework at home, which when the family is large is often, as will be shown later, as hard and exacting as many forms of gainful employment; and, finally, to omit mention of other difficulties and limitations inherent in house-to-house investigations of the kind, they do not adequately consider the indirect influence of the employment of married women and mothers and the continued absence of housewives from their homes during a large part of the day on the home standards and the standards of infant and child care of the neighborhood and community. The subject is not so simple as our treatment of it so far would seem to indicate.

III. INDIRECT INFLUENCES

So far we have been dealing primarily with the direct influence of the employment of mothers in gainful occupations on infant mortality — that is, the effect which the work in which the mother is engaged has on the chances of survival of her own infant during the first year after confinement. We have only incidentally made reference to the indirect effect which the employment of a large number of mothers in gainful occupations in a community may have on the mortality of their neighbor's children. This aspect of the problem must now be considered with some care.

As has already been shown, the continual absence of the mother from the home either because she is engaged in some gainful occupation or for any other reason tends to lower the efficiency of the home as “ a place for babies to grow up in ”; and the same effect also follows, tho perhaps, to a less degree, when the mother is engaged in some gainful occupation within the home. Such employment of the mother may lower or impair the efficiency of the home in a number of ways, many of which have been pointed out already. It may deprive the baby of the mother's care without furnishing a satisfactory substitute therefor; it may necessitate the use of bottle feeding; it may prevent the mother from keeping the baby or the home in as cleanly condition as she might otherwise be able to do; and it may strengthen the tendency for the mother to lapse in the observance of the ordinary rules of hygiene and child care. Moreover, — what is especially important in this connection, — the influence of the employment of mothers in gainful occupations on the efficiency of the home may reach out to the homes of other mothers who are not engaged in any gainful occupation and may never have been, and

thus help to lower the general domestic and hygienic standards of the community.

This tendency was clearly evident in the four wards included in the Boston inquiry, where it was found that in spite of numerous individual exceptions the homes of the mothers who were not engaged in any gainful occupation did not as a class present any striking differences from the homes of those who were. The same condition has also been noted in other similar investigations.¹ This similarity in the homes of these two classes of mothers is probably the result of a number of influences, among the most important of which is the indirect influence of the employment of mothers and married women in gainful occupations on the general home standards of the community. All the families who live in a community help to create the general home standards for that community. The mothers who work do not create one standard for their families and those who do not work another somewhat higher for theirs.

In the light of this it is not surprising that the mortality rate for infants born to mothers who are engaged in gainful occupations does not vary markedly from the rate for those infants born to mothers who are not so employed. The truth of the matter probably is, not that the gainful employment of mothers does not affect the chances of life of infants born to such mothers, but that *it does not affect their chances exclusively*. The effect doubtless falls upon them and their homes first and most severely. But a condition which exists in a large proportion of the homes of a neighborhood, or of an entire city, will probably in time affect other homes also; and the case of the gainful employment of married women

¹ Thus, in the Birmingham report (1910, p. 5) it is stated that "the home conditions of those industrially employed do not differ to any large extent from those not so employed."

outside the home is no exception. While not subject to statistical demonstration, it is highly probable that in the cities of England and the United States where a large proportion of married women are engaged in gainful occupations, a condition has resulted that has lowered the standards of home life and child care of the entire city, at least of the factory neighborhoods. The influence of this factor of infant mortality is therefore not individual, in the sense that it affects only or principally those mothers who, during pregnancy or while having children under one year of age, are engaged in gainful occupations; it is social, in the sense that it affects all women regardless of the fact of occupation. "No man liveth unto himself and no man dieth unto himself."

Besides its influence upon home and community standards the employment of girls and young women in gainful occupations may exercise an important *indirect* influence on the rate of mortality of infants by sapping the strength and vitality of potential mothers and by affecting the training and education of the mothers of the next generation. The rate of infant mortality may be affected by the employment of women before marriage as well as during pregnancy or during the first year after confinement. Dr. Robertson, Medical Officer of Health of Birmingham, England, in the report on infant mortality in that city from which we have already had occasion to quote, lays great emphasis on this point. He says, "I regard as probably one of the most important influences of the industrial employment of women the obvious fact that girls and young women who are in industrial work for many hours daily can have but little time to make themselves practically familiar with the very numerous and often apparently unimportant matters which make all the difference between a well-ordered

home and one which lacks the influence of a capable mother.”¹

Since the employment of women and mothers in gainful occupations thus affects the rate of infant mortality indirectly in several ways, it is manifestly impossible to measure the influence of the employment of mothers on infant mortality by comparing the rate for the children whose mothers were employed during pregnancy, or during the first year after confinement, with the rate for those children whose mothers were not employed during these periods. To measure with any degree of accuracy the influence of any factor on the problem, the effect of that factor must be “isolated.” It is impossible to “isolate” the factor of employment because it affects to a greater or less degree the entire community. There is still another reason, however, that seems also to show that the statistics quoted in the early part of this article, which on their face seem to minimize the importance of the employment of women in gainful occupations as a factor in infant mortality, are not conclusive. This other neglected factor of infant mortality must now be considered in detail.

IV. INFLUENCE OF HOUSEWORK

In past discussion the assumption has too often been made that the only kind of employment that can have an appreciable influence on the mortality rate of infants is gainful employment. Such an assumption, however, as will be evident from even a cursory examination of its basis, is false. Work is work and employment is employment, whether it be housework or factory labor; or whether it be in the mother's own home or in some other woman's home, whether it be for hire or simply to keep the mother's own house in order and her own

¹ *Loc. cit.*, Report for 1910, p. 16.

family clothed and fed. Tho gainful employment is likely on the whole to have a more harmful influence on infant mortality than the employment of mothers in the performance of their own household duties, it does not follow that the influence of the latter can safely be disregarded.

A good example of the similarity of the influence on infant mortality of the employment of mothers in gainful occupations and in the performance of their own household duties is seen in the length of time the two classes of mothers left off work before confinement and began again afterwards. It was shown by the Fall River,¹ Boston, and Johnstown investigations that a considerable proportion of the mothers employed in gainful occupations did not stop work until less than two weeks before confinement (9 per cent in Fall River) and that a large proportion did not stop until a month before confinement (21 per cent in Fall River). This failure to stop work a sufficiently long time before confinement is generally recognized as a factor in infant mortality. But it is not a factor the influence of which is confined solely to the children of the gainfully employed mothers. Both the Boston and Johnstown investigations showed that a much larger proportion of the mothers employed only in the performance of their own household duties continued to work very close up to confinement. Moreover, the results of these investigations also show that both classes of mothers began work again too soon after confinement.² Thus the effect of this factor of infant mortality, altho probably exercising a more serious influence in the case of gainfully employed mothers, is present in the case of the children of mothers not gainfully employed.

¹ Loc. cit., p. 111.

² For Johnstown, see loc. cit., pp. 44-45. Of the mothers visited by the Research Department of the Boston School for Social Workers 21 per cent began work less than one week after confinement and more than 60 per cent less than two weeks.

It is not possible to compare the character of the work done by mothers who are employed simply in the performance of their own household duties with that of the mothers who are gainfully employed, in such a way as to measure the relative effect of each kind of work on infant mortality. Yet practically all of the recent investigations that have dealt with this phase of the subject have brought out the fact that the conditions under which mothers perform their household duties at home, and the amount and character of this work, are often such as to have an injurious effect on their own health and that of their babies. Thus in the Boston investigation it was found that the conditions under which the mother worked at home were often no better than those of the factory and in many cases the work itself was no lighter. Dr. Robertson also found a similar state of affairs to exist in his study of infant mortality in two wards of Birmingham, England, to which reference has already been made. The same condition is also alluded to in the report of the Fall River investigation. Thus "the character of the work . . . seemed to be as important an apparent cause of stillbirths among the mothers who were engaged at their own housework as among those who were employed in mills." Moreover, a slightly larger proportion of the children of "mothers at housework only" (54 per cent) were reported as "not well and strong at birth" than of "mothers at millwork" (53 per cent). In commenting on these figures the writer says:

"The significance of these figures appears to be not in the slight excess of children not well and strong at birth, but in the fact that for the mothers at home the percentage is practically as high, plainly indicating that if there is an injurious effect of millwork, there must also be in many of these cases an effect almost in the same degree injurious resulting from the work at home."¹

¹ Loc. cit., pp. 104, 110-111.

It is, thus, evident that the influence of the employment of mothers on infant mortality is not confined exclusively to children whose mothers are gainfully employed. The essential thing is the work which the mother has to do, not whether she is paid for her work or not. Where the hours are long and the conditions under which the work is done are inconvenient or unsanitary, where the work itself is heavy and exacting, and where it is continued close on to the day of confinement and begun again soon afterwards we may expect that in the long run the influence on infant mortality will be bad, whether the particular work done be the mother's own housework, some form of factory labor, or some other work for which she receives a definite wage.

All this is equivalent to saying that the figures presented in the previous section on the statistical evidence are inconclusive. If, first, the influence of gainful employment, so far from being confined exclusively to infants born to mothers who are gainfully employed during pregnancy or during the first year after confinement, affects indirectly, through its influence on home and community standards of child care, the chances of survival of infants whose mothers are not gainfully employed; and if, second, the influence of employment — that is, of the work which the mother does, is active in both groups, it is hardly to be expected that a comparison of the mortality rate of infants born to mothers who are employed in gainful occupations with the rate for those whose mothers are employed simply in the performance of their own household duties will yield any conclusive results. But still another difficulty with this method of measuring the influence of the employment of the mother on infant mortality remains yet to be considered. This arises from the close interrelationship of the influence of the employment of the mother and poverty.

V. INFLUENCE OF POVERTY

The relationship between poverty and infant mortality was first made the subject of statistical study by Charles Booth as a part of his investigation of East London. He classified the thirty-three residence districts of the city which were selected for study into three groups according to the proportion of the population living in poverty and in crowded quarters and compared the infant mortality rates for the groups. In the first group, which contained the largest proportion of the "poor and overcrowded," the rate was 169 deaths per 1,000 births; in the second group, containing the largest proportion of people of "the comfortable central class," it was considerably less (148); while in the third group which contained the largest proportion of the "upper classes," it was lowest of all (132).¹

Later, in 1898, Rowntree made a similar investigation of "vital statistics of typical sections of the population of York, England," including infant mortality. He divided the population of the city into four classes and compiled the rate of infant mortality for each class. The rate for the "poorest working class" was highest of all, 247 deaths per 1,000 births; for the "middle working class" considerably lower, 184; for the highest working class lower still, 173; and for the "servant keeping class" lowest of all, 94.²

The objection to the method employed in both these investigations, altho not of sufficient importance to seriously weaken the conclusions drawn, is that the unit considered was not the individual family but selected areas. Later investigations have avoided this objection by comparing the infant mortality rates for different

¹ Charles Booth, *Life and Labour of the People of East London*, 1903. Final volume, pp. 26-27.

² B. S. Rowntree, *Poverty; A Study of Town Life*, 1901.

families classified by income. This method was used in the investigation by the Health Department of the City of Birmingham, England, in the investigation to which reference has been made several times already. Among the infants whose fathers were "out of work or earning less than one pound per week" the mortality rate during the two years of the investigation was 204 deaths per 1,000 births; while for the infants whose fathers earned more than one pound per week the rate was considerably less, 137.¹ Thus, in these two wards of the city, both of which were "occupied almost entirely by poor people," the infant mortality rate varied markedly with the wages of the father.

Before leaving the results of the British investigations of this phase of the subject attention should at least be called to the tabulation which the registrar-general of England and Wales made in his last annual report showing the relationship between infant mortality and the father's occupation.² The results, altho they cannot be quoted in detail, showed quite clearly the effects of poverty and its accompaniments on infant mortality, since everywhere the rate of mortality was higher among the babies whose fathers were employed in the poorly paid occupations than among those whose fathers were better paid.

The best as well as the latest American investigation of the relation between poverty and infant mortality was made by the federal Children's Bureau as a part of its comprehensive study of infant mortality in Johnstown, Pennsylvania. The data gathered in this inquiry are of especial value in this connection, since all the babies born in the city during the year of the investigation were included, not simply those born in a particular

¹ Report on Infant Mortality in St. Stephen's and St. George's Wards, 1912, p. 11.

² Registrar-general for Births, Deaths, and Marriages in England and Wales, Annual Report for 1912.

section or in relatively poorer families. The results are summarized in the following table, which shows the mortality rate per 1,000 births for the infants included in the investigation, classified according to the annual earnings of the father:¹

	Number of Births	Infant Mortality Rate
Total.....	1,431	130.7
Annual earnings of father, under \$521.....	219	255.7
“ “ “ \$521 to \$624.....	165	157.6
“ “ “ \$625 to \$899.....	385	122.1
“ “ “ \$900 to \$1,199....	138	101.4
“ “ “ \$1,200 or more ...	48	83.3
“ “ “ “ Ample ”	476	84.0

Thus the infant mortality rate varies closely with the amount of the annual earnings of the father. For the infants whose fathers earned less than \$521 annually the rate was twice as great as that for infants whose fathers earned between \$625 and \$799 annually, and three times as great as the rate for those infants whose fathers earned \$1,200 or more. The relationship is a very close one — as close a one as one can well expect to find in vital statistics. The question remains for determination: is the relationship between poverty and infant mortality as close a one as the relationship between the employment of the mother and infant mortality?

As has been shown already, families in which the mother is gainfully employed differ radically in respect to the father's income from those in which the mother is not so employed. Thus, 48 per cent of the husbands included in the Johnstown investigation who received less than \$521 annually had wage-earning wives, in comparison with 33 per cent of those who received from \$521 to \$624, and 22 per cent of those who received from \$625 to \$779 a year. Only 9 per cent of the husbands who had

¹ U. S. Children's Bureau, *Infant Mortality: Johnstown, Pa.* Washington, 1915, p. 46.

an annual income of \$900 to \$1,199 a year had wage-earning wives and only 2 per cent of those whose income was \$1,200 a year or over.¹ It is, of course, to be expected that the great majority of wage-earning mothers should have husbands whose annual earnings are small. But the significance of this fact in relation to the influence of the employment of mothers in gainful occupations on infant mortality has by no means always been fully appreciated. It may seem that in one sense the employment of mothers in gainful occupations is not so much a cause of the high rate of infant mortality as it is a sort of remedy for the adverse influence of poverty. Before going further into this subject, however, it will be necessary to compare, as far as the difficulty of distinguishing the effect of the one from the other makes possible, the relative influence of these two factors on the problem. Such a comparison is possible from the figures quoted in the following table from the reports of the Birmingham, England, and the Johnstown, Pa., investigations showing the mortality rate for infants classified both according to the annual earnings of the father and the employment of the mother:

JOHNSTOWN ²

	Mother Gainfully Employed	Mother Not Gainfully Employed
Total.....	188	118
Annual earnings of father, under \$521	248	263
“ “ “ \$521 to \$624	151	161
“ “ “ 625 to \$779	127	102
“ “ “ 780 or over, or ample	167	93

BIRMINGHAM ³

Total	176	170
Out of work or less than one pound weekly ...	208	195
More than one pound weekly	118	152

¹ Loc. cit., p. 48.² Ibid., p. 49.³ Ibid., 1912, p. 11.

A careful examination of the figures seems to indicate that the influence of poverty in these families is much greater than that of the employment of the mother. In Birmingham the infant mortality rate varies very slightly with the employment of the mother, while the variation with the earning capacity of the father is marked. This latter fact is especially significant when it is remembered that the families visited did not vary greatly as to income, the two wards included being "occupied almost entirely by poor people." In Johnstown, also, the amount of the father's annual earnings seems to vary more closely with infant mortality than with the employment of the mother. Moreover, as has been shown already, it is very probable that the higher rate shown in the table for the children of the gainfully employed mothers is produced, not by the influence of gainful employment at all, but of poverty. It must not be forgotten that the mothers who were gainfully employed were for the most part living in poverty while those who were not so employed were in comparison relatively well-to-do.

As Dr. Robertson says in commenting on the results of the Birmingham inquiry, "the life of the mother among the poorer classes is always a strenuous one if the family is large. . . . It does not matter much whether the mother is industrially employed or not . . . if poverty is great the infant suffers. . . . From the tables [given in his report] it is seen that the influence of poverty . . . on the infant mortality rate is far greater than that of industrial employment." To this conclusion the present writer must subscribe, for all the data presented tend to emphasize the fundamental importance of the relationship of poverty to infant mortality.

The relation of poverty to hygienic and home conditions remains to be pointed out, altho this is not the

place for an adequate discussion of this phase of the problem. As an experienced English medical officer of health writes to Dr. Newman, — “ Infant mortality in Lancashire is, I am sorry to say, as much a financial as a hygienic question. . . . A weaver’s wages will not allow of the wife’s remaining at home, considering rents and rates, and so both go — which is the rule — and a hand to mouth existence results even for themselves, let alone the little ones. . . . Much good may be done by hygienic tuition, but I am certain that the root of the whole matter with us is, as I have said, comparatively low wages and high rents and rates,”¹ — or, as one would say in America, low wages and a high cost of living.

VI. CONCLUSION

It appears, then, that the fundamental cause of the excessive rate of infant mortality in industrial communities is poverty, inadequate incomes, and low standards of living with their attendant evils, including the gainful employment of mothers. The employment of the mother in gainful occupations is simply the remedy for these evils or “ adverse conditions ” which the working people in industrial communities have adopted. Undoubtedly, this recourse has had an important effect on the problem, in many cases actually tending to reduce the rate of infant mortality, while in others having just the opposite effect. The primary question in considering the social causes of infant mortality is whether the employment of mothers and married women in extradomestic occupations is, from the viewpoint of society as a whole, a good remedy for poverty and an acceptable means of mitigating its influence on the health and mortality of babies and young children. From the point of view of

¹ Quoted in Newman’s *Infant Mortality*. London, 1906, pp. 137–138.

the individual poor or poverty stricken family, the fact cannot be escaped that this effect may be both good and bad: bad, in that it causes the baby to be artificially fed, forces the mother to be absent from home, and in other ways lowers her efficiency as a mother; good, in that it increases the family income and decreases the influence of poverty. We are, thus, forced to conclude that the fundamental economic and industrial factor of infant mortality is low wages. The fundamental remedy is obviously higher wages. Other remedies, such as legislation restricting or regulating the employment of mothers before and after confinement,¹ day nurseries, the instruction of mothers and school girls in domestic economy, and the like, all have their place; but the chief thing remains the provision of an adequate family income.

¹ In commenting on this phase of the problem, Dr. Robertson, in his Report on the Industrial Employment of Married Women and Infant Mortality in St. Stephens and St. George's Wards, Birmingham, England (for the year 1910, p. 21) says: "It appears to be a question in this Birmingham area whether the additional poverty which would be occasioned by preventing mothers from working for, say, six months after a birth, would not be the greater of the two evils."

VITA

The writer was born in Smithland, Ky., November 25, 1887. In 1908 he graduated from Williamsburg (Ky.) Institute. He received the A. B. degree from Brown University in 1910 and the A. M. degree in 1911. In 1910-12 he held a Fellowship in the research department of the Boston School for Social Workers. While in Boston he was a resident of the St. Mary's House for Sailors and also of South End House and in addition was a member of Conference 7 of the Associated Charities. In 1911-12 he attended a course in sociology under Prof. T. N. Carver at Harvard University. In 1912-13 he taught history and social science in Tarleton College (Texas) and in 1914-15 sociology and statistics at the University of Illinois. In 1915 he was a lecturer in the Summer School for Social and Religious Workers conducted by the Biblical Department of Vanderbilt University and the American Interchurch College. He was registered at Columbia University in 1913-14 and 1915-16, attending courses under Professors Giddings and Tenney in sociology, under Professors Seligman and Seager in Economics, under Professor Devine in Social Economy, and Professor Chaddock in Statistics.

